Electrical World

Published by McGraw Publishing Company, Inc.

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

Vol. 62 NEW YORK, SATURDAY, NOVEMBER 15, 1913 No. 20

Commission as Arbitrator

At the request of Governor Ralston of Indiana, the Public Service Commission of that State is acting as a board of arbitration to settle differences between the Indianapolis Traction & Terminal Company and its striking employees. It is reported that before the commission decided to act the company was forced to consent to arbitration as a method of settlement. This is an astonishing procedure. Nothing in the law provides that the commission shall arbitrate labor difficulties. Everything in the spirit of public service commission regulation is rigidly opposed to such an act on the part of a body of this character. We are not discussing the question of whether the company should have been forced to arbitrate. Perhaps that seemed to the public authorities to be the only possible method of settlement of a disastrous and murderous strike. The Public Service Commission, however, was not the one to force it. Its duties with respect to the companies are definitely and clearly set forth in the law. It can do no higher service to the State than to administer the law so as to assure a reasonable policy on the part of the corporation and the public toward each other in regard to matters over which it has jurisdiction. When it goes beyond those matters and takes upon itself the painful task of arbitration in a case like this it opens the way to an alarming loss of prestige. Such arbitration seldom gives satisfaction to both parties. We hope that the Indiana commission, which may have gone into the arbitration without a full realization of all that it meant, will conduct itself so creditably as to disarm criticism. The precedent which it has set is one that should be avoided by other commissions.

Developments Near Chattanooga

The hydroelectric development of the Chattanooga & Tennessee River Power Company, built by the late A. N. Brady, but which he never saw, was placed in operation on Thursday of this week with appropriate ceremonies. Erected at a cost of approximately $9,000,000, the station has the distinction of being the largest single hydroelectric plant in the South. The lock which forms part of the dam is also the largest single-lift lock in the country, and it is hoped that owing to the improvements in the river thus secured important water traffic will be inaugurated between Chattanooga and the sea. Certainly the government has spent an enormous amount of money on improvements in the Tennessee River in addition to that which was spent at Hales Bar by Mr. Brady for the sake of enabling a few boats to reach Chattanooga from the Mississippi and the Gulf. Great as are the advantages to Chattanooga from this dual enterprise, it is unfortunate that the station is without appreciable load, and it will be a long while before anything is realized on the investment. An immense amount of time and money was consumed in erecting the dam and station owing to fissures in the rock on which they are built. At the time work was started there was an excellent market for the energy. Meanwhile, however, the first hydroelectric development of the Tennessee Power Company on the Ocoee River was begun and completed and the second development also completed. The transmission lines of the latter company extend now as far south as Rome, Ga., and supply energy to Cleveland, Knoxville, Nashville and Chattanooga, Tenn., and other cities in the immediate vicinity. In other words, while the Hales Bar station was being built the cream of the business was taken by the Tennessee Power Company, owned by E. W. Clark & Company, of Philadelphia, and Hodenpyl, Hardy & Company, of New York City. There is still, however, a vast quantity of smoke and soot in Chattanooga, so that the market for electricity is by no means saturated. It would not be surprising, therefore, in view of the great hydroelectrical developments at its doors, if Chattanooga should become the electric city of the South.

Patent Litigation

Probably there are few better examples of the intricacies and vicissitudes of patent litigation, not to mention the huge burden of expense, than the last decision in the suspension insulator case, given on another page. Taking the case in abstract, one inventor conceived a patentable idea and procured a patent in the usual way, proceeding thereafter to use the patent for commercial gain in an established business. The Patent Office some time afterward announced that the patent was "inadvertently" issued and declared interference with a prior application for a patent not then issued. Here it may be observed that, under present procedure, applications may be kept dangling in the office for years, if desired, and such practices are sometimes resorted to as a dragnet to catch possible competitors and involve them in litigation. By the same means the life of the inventor's (or his assignee's) monopoly is extended. Then the examiner of interferences, after due hearings and proceedings, all expensive for the inventor, decided in this case that the earlier applicant was the prior inventor. This decision was appealed to the board of examiners, and the first decision affirmed. Subsequently the two inventors appealed in turn to the Patent Commissioner, the Court of Appeals of the District of Columbia, the United States District Court and the United States Court of Appeals, and possibly the case will finally go to the Supreme Court. A better argument for a single court of patent appeals

with considerable cutting out of intermediate appeals in the Patent Office, could hardly be imagined. The obvious advantages of such a court in curing existing abuses have been widely extolled, even by those who hold that patent reform as a whole has no ground to stand upon. This, of course, is only one of the fragments in a situation which needs the prolonged and careful study of the ablest body of disinterested, high-minded men which can be drawn together. The signs are not wanting that when Congress next convenes in regular session the champions of patent reform will be able to accomplish something.

Wave-Form in Surges

The general laws of the growth and decay of electric currents in conductors are now fairly simple in their outlines, which means that these outlines are fairly well understood. The detail of these laws is, however, still enshrouded in abstract lengthy and non-arithmetical mathematics, which means that this detail is not yet fully understood. A ponderous equation is ordinarily a cloak for the safer protection of ignorance, although it may have been fairly arrived at and may honestly represent the best existing human knowledge on the subject.

It is now generally admitted that when an electric circuit is closed to an electromotive force of any assigned type an electric wave runs out into space, permeating the insulating medium, but guided by the conductor of the circuit. The wave advances through the insulating medium at the "light velocity" of that medium and undergoes reflections or refractions at discontinuities either in the medium or in the conductor. The initial electric disturbance is propagated through the insulator, while the final steady transmission of electricity is propagated through the conductor. The entire set of phenomena, in insulator and conductor combined, is called an electric current.

The propagation of electric disturbance through the insulating medium is subject to laws of wave motion in an elastic medium. It was worked out mathematically by Maxwell, and experimentally by Hertz. The steady process of current flow, or the handing on of electric charges from point to point along a circuit, apparently involves movements of electrons in conducting material and follows the law of Ohm. But the moment a steady current is interrupted by opening a switch, or, going further, the moment a current is changed suddenly from one steady strength to another, electric wave disturbances are propagated over the circuit through the surrounding dielectric. Under very simple conditions, these waves may be computed with ease, but under the varying conditions that occur in practice they are so complex that they elude all known quantitative methods. A long article on overvoltage surge wave-forms by Dr. P. M. Verhoeckx has recently appeared in *Elektrotechnik und Maschinenbau*. The mathematical theory of the wave transmission is there developed in studious but somewhat forbidding form. It shows that, even in comparatively simple cases, a complete solution of the problem is very difficult to secure. What is most needed is experimental development of the subject under definite, fairly simple conditions, whereby statistics may be obtained and accumulated, even although they can be explained only imperfectly. Later on the mathematical treatment will doubtless become simplified to meet the statistical requirements.

Swiss Single-Phase Locomotives

The latest locomotives built for the Loetschberg line, opened early this summer, are among the most powerful, if not actually the most powerful, locomotives utilizing single-phase energy. The detailed description elsewhere in our columns gives a good idea of the characteristics of the machines and the particular features of construction that have been introduced to meet the difficulties of the service. The Loetschberg system is operated by single-phase energy at 15 cycles per second, and the working conductors carry 15,000 volts. The locomotives take energy from the line by two pantograph trolleys, which, it may be added, work with the utmost smoothness. The heavy service, with express trains operating over grades exceeding 2 per cent, requires a large machine and each locomotive actually weighs 107 metric tons.

Perhaps the most striking feature of the locomotive is the rather remarkable mechanical drive. The whole machine, which is some 52 ft. in over-all length, is provided with five pairs of coupled drivers and a pony axle and wheels at each end in addition. The two large motors to furnish the 2500 rated hp required are placed side by side in the center of the locomotive, the transformers and switch gear being at each end. Each of the motors drives through helical gearing a crank shaft, and the two crank shafts, each counterbalanced, are connected to each other and to the crank pin of the center driving wheels by means of a triangular steel truss which serves as a connecting rod. The two motors therefore pull together on the central axle, ordinary external connecting rods uniting this central pair with the other four pairs of driving wheels. Similar driving wheel connections are to be found on the Sondrio-Lecco line in Italy, and while they certainly look queer to the casual observer, they seem to function admirably.

The lateral flexibility required on the Loetschberg line, which has some fairly sharp curves, is provided in an unusual way. Obviously the particular nature of the connecting gear forbids anything like true articulation, and hence the freedom of motion is obtained by giving liberal end-play to the center driving axle and to the two end driving axles, the intermediate pair of axles having little or no play and the pony axles having even more than the driving axles adjacent to them. It is apparent that the arrangement is in effect an articulation as regards the driving axles, the center axle and end axles virtually pivoting about the intermediate one by reason of the end-play. Electrically, although the two motors are coupled together, each half of the equipment is independent so that the locomotive can be driven by one motor if necessary.

The motors themselves are of the compensated series interpole construction, with sixteen poles and wound for a maximum emf of 500 volts. The power-factor at normal speeds is about 95 per cent, and the efficiency from trolley to rim of driving wheel runs as high as 88 per cent. The

maximum drawbar pull of the locomotive is about 40,000 lb. and its full-load drawbar pull about 30,000. The motors do their work well and the operation is reported to be practically sparkless and altogether satisfactory. Of course, the severest test of such motors is during the period of acceleration when the maximum heating occurs. On the whole, the performance seems to be highly successful. It is altogether the most spectacular main line electric railway equipment in Europe, and the results obtained with it are such as to give much encouragement to trunk line electrification.

Effective Reactance and Resistance

The article by Mr. Waldo V. Lyon which appears on page 1006 draws attention to certain conditions in alternating-current circuits not generally recognized but of considerable practical importance. When a sinusoidal emf acts upon a simple circuit of resistance and inductance, with no losses except simple joulean losses in the conductor, the apparent resistance of the conductor, as judged from its impedance, is known to be substantially equal to the resistance as measured by continuous current. This, at least, is the practical condition when the frequency of the alternating current is, say, less than 100 cycles per second, or such as is used in ordinary industrial distribution circuits. When the frequency of the current runs into the telephonic range, then it is well known that, even when no core losses occur, the change in current density over the cross-section of the conductor, commonly referred to as the "skin effect," causes the apparent resistance of the conductor, as judged from its impedance, to exceed that encountered by continuous currents. The effect is very marked at radio frequencies. For this reason the author confines his attention to alternating currents of industrial low frequency.

It is further shown that when core losses occur, whether they are due to hysteresis or to eddy currents in the core, they invariably tend to advance the phase of the current in the circuit, thus bringing the impressed emf and current more nearly into phase. They also tend to increase the apparent resistance with respect to the continuous-current resistance and to diminish the apparent reactance with respect to the actual reactance. The only essential difference in this respect between hysteretic loss and eddy-current loss in the core lies in the fact that the former involves distortion in the current, especially by the development of a powerful triple-frequency harmonic component of current, whereas the latter does not involve distortion. It is shown, moreover, that the increase in apparent resistance is greatest when the angle of core-loss advance amounts to 45 deg.—a fact not generally known.

Although the author considers only reactance coils and does not specifically refer to secondary circuits, yet, by implication, such secondary circuits are involved with eddy-current losses, and the reasoning applies to transformers in general, as well as to reactance coils. The final vector diagram might, therefore, be considered as applying to transformers under load, except that the component of eddy-current loss would have to be made capable of some range of phase variation, in order to include secondary-circuit loads. The relation pointed out, that the angle of core-loss advance has for its tangent the increase in apparent resistance divided by the apparent reactance, is a useful one. Strictly speaking, of course, it applies rigidly only to sinusoidal currents. Although the concept of equivalent sinusoidal currents may be used with advantage when the distortion is small, it is well known that it may break down completely when the distortion is great.

Industrial Lighting

Mr. Ward Harrison's article in this issue on lighting will serve as an admirable guide to those who are installing incandescent lamps for industrial purposes. It is a careful and thorough account of the general requirements of such lighting and the methods that have proved effective in meeting them. From a practical standpoint it should prove most useful and is sufficient in detail to serve well for general purposes. Of course, one must understand at the start that general methods, even when so clearly put as they here are, cannot be used for every imaginable purpose. There are times when to meet certain specific conditions there is needed a great deal of finesse which nothing but the combination of keen intelligence and considerable experience can provide. In applying the principles laid down by the author the chief difficulty will be found in cases where rigid economy is necessary and where consequently every device that ingenuity can suggest in the way of getting efficient lighting has to be utilized, sometimes to the confusion of general schemes of illumination.

Of the many features of the subject to which, did space permit, we should like to call attention, one has so often been misunderstood that it deserves special comment, namely, glare. To this Mr. Harrison refers in extremely plain and most sensible terms. His definition as "light out of place" conveys perhaps the best idea of its characteristics, but the particular fact which Mr. Harrison brings to the surface is that quantity of light as well as position of the lamps is an important matter. It is, in all probability, true that the effect of glare depends very largely on the total light flux involved in it, a consideration which is too often forgotten.

After all, glare is merely a question as to the amount of light energy that reaches the retina and disturbs its normal activities. For instance, one may receive specular reflection from an arc lamp half a mile away without being disturbed by it in the slightest degree, while if it were 20 ft. away the effect would be disagreeable in the extreme. This is, of course, an exaggerated case, but it points an important moral which we are glad to find in Mr. Harrison's paper. Extraneous light falling on the retina even from diffuse sources will prove troublesome if there is enough of it, and will be harmless if small in amount. These quantitative relations of light and vision have been kept altogether too much in the background in the earlier work on illumination. In point of fact, they are all-important and deserve very close investigation. As a general account of the methods and appliances used in industrial lighting Mr. Harrison's paper deserves close reading and will prove stimulating and valuable.

The News of the Week

Activities and Events in the Electrical Field—Reports of Meetings—Commission Findings, Etc.

Service in Cleveland Crippled by Blizzard

On Sunday night a terrific storm struck the city of Cleveland, Ohio, and continued unabated with heavy snow all during Monday and Tuesday, inflicting heavy damage to manufacturing and shipping as well as crippling the services of the telegraph and telephone companies, the electric-light company, the railway companies and the trunk lines entering the city. As we go to press no estimate of losses can be made by the companies having wire systems in the city. In various sections poles were broken and wires were piled in tangled masses for blocks. This was especially true near 105th Street, East, and in Collinwood, a suburb of Cleveland, as well as along Superior, St. Claire and Euclid Avenues and in the southern part of the city. The damage was not less severe on the West Side, where street railway service was suspended until Wednesday morning.

For hours Sunday night there was a vivid display of light caused by broken wires coming in contact with each other, but only one fatality from this cause has been reported notwithstanding that the ground was apparently covered with wires. The Cleveland Electric Illuminating Company opened its circuits as soon as the conditions became known, and many of the sections of Cleveland were still without electric service for lamps and motors on Wednesday night. The company advertised extensively in the local papers, stating that under the circumstances it would adhere to the policy of "Safety before service."

The city was entirely isolated from other portions of the country on Monday, neither telegraph nor telephone lines working, and even on Tuesday no lines other than the press wires were open for service. Telegrams were carried on trains by messengers in the shortest time possible, or sent by special delivery mail. The telephone service was badly crippled locally, and where greatest havoc was wrought by the storm no service is yet being rendered. The telegraph companies on Thursday were getting their lines cleared up and expected to have them in fair shape shortly. Up to Thursday morning it was impossible to make repairs on the lines and service of both the lighting and telephone companies. The wires were at that time being gathered from the streets and preparations made for rapid repairs. It is expected that complete lighting and telephone service will be restored by the end of the week.

National Conservation Congress

The official call for the fifth National Conservation Congress, which, as already noted in these columns, will be held in Washington, D. C., on Nov. 17, 18, 19 and 20, says that protection of forests and waterways is the great conservation issue to-day, and that within the next few months it will be discussed in the United States Congress and in State legislatures. For this reason the congress is to be devoted largely to forest conservation, in which there is public interest because upon the proper solution of the various problems depends the cost of wood, the perpetuation of the timber supply, the development of hydroelectric power, the utilization of non-agricultural lands, the availability of water for irrigation and the preservation of forest areas for health and recreation.

It is expected that President Wilson will address the congress, as well as members of the Cabinet, senators, representatives and chiefs of government bureaus. The following committee of delegates to attend the congress has been appointed by the American Institute of Electrical Engineers: Mr. H. G. Stott, New York, chairman; Mr. H. C. Eddy, Washington, D. C.; Mr. John H. Finney, Washington, D. C.; Mr. S. Z. Mitchell, New York, and Mr. F. B. H. Paine, New York.

Annual Meeting of the American Society of Mechanical Engineers

Among the papers to be read at the annual meeting of the American Society of Mechanical Engineers, to be held in New York from Dec. 2 to 5, several which are of interest to electrical engineers are as follows: "The Fire Hazard in Turbo-Generators," by Mr. G. S. Lawler; "Notes on the Further Operation of Large Boilers of the Detroit Edison Company," by Mr. J. W. Parker; "Properties of Steam," by Mr. R. C. H. Heck; "On Setting Tasks for Firemen and Maintaining High Efficiency in Boiler Plants," by Mr. Walter N. Polakov, and "Extinguishing Fires in Oils and Volatile Liquids," by Mr. Edward A. Barrier. On Wednesday evening, Dec. 3, Mr. John W. Lieb, Jr., past president American Institute of Electrical Engineers and past vice-president American Society of Mechanical Engineers, will deliver an address, illustrated by lantern views, on "Leonardo da Vinci—Engineer and Artist."

Mr. Lieb's address will follow the presentation of the Grashof Medal by the Verein deutscher Ingenieure to Mr. George Westinghouse, past-president and honorary member of the American Society of Mechanical Engineers.

New Decision in Suspension-Insulator Patent Case

In a decision by the Commissioner of Patents in the interference proceedings known as Steinberger versus Hewlett, recorded in our issue of Dec. 21, 1912, page 1300, priority of invention of the suspension or disk strain type of insulator was awarded to Steinberger, validating his patent No. 904,370, issued Nov. 17, 1908. The invention in question consisted of a disk strain insulator comprising suspension members partially enveloped by a mass of insulating material and having a disk portion provided with annular collars or flanges extending in opposite directions therefrom and generally parallel with the suspension members. Although a patent for this had been issued to Mr. Louis Steinberger, the examiner of interferences on Nov. 2, 1911, awarded priority to another claimant, Mr. E. M. Hewlett. The examiners in chief upheld this decision on April 29, 1912, but the First Assistant Commissioner reversed the findings in a decision dated Aug. 6, 1912. On April 26, 1913, the Court of Appeals of the District of Columbia upheld Steinberger's priority. Subsequent proceedings were then instituted by the General Electric Company in the United States District Court for the Eastern District of New York, before Judge Chatfield in Brooklyn, the complainants availing themselves of a right granted in Section 4915 of the United States Revised Statutes.

Judge Chatfield rendered a decision on Oct. 9 reversing the award to Steinberger and declaring Hewlett the prior inventor. Supplementary opinions were filed on Oct. 18 and Oct. 21. The District Court held that the patentable invention lay in the use of annular flanges, which would accomplish watershedding and insulating area-protecting purposes, under the conditions described in the drawings and specifications of the applicants.

An appeal from Judge Chatfield's decision has already been filed by the defendant.

The Anglo-American Exposition

In connection with the Anglo-American Exposition which is to be held in London, England, to celebrate the centenary of peace and progress in the arts, sciences and industries of the United States and the British Empire from May to October of next year, Past-president W. M. Mordey of the Institution of Mechanical Engineers, at a meeting recently held in London, spoke on behalf of the electrical committee which is arranging for the British exhibits. He said that it seemed fitting that the electrical engineers of America and of England should co-operate in showing to the world the wonderful engineering developments of the past century. He gave a résumé of the work of the pioneers in electrical science—Franklin, Faraday and Davy—and declared that a place of honor at the exposition rightfully belongs to electrical engineering developments.

The object of the Anglo-American Exposition is to increase the friendly feeling between the British and American peoples. The Shepherd's Bush section of London is the site of the exposition grounds. Prominent members of the American Society in London, with whom the idea of the celebration originated, and many of the most influential men in English affairs are interested in its success. The American executive offices are in the Woolworth Building, New York. The general offices are in the Administration Buildings, Shepherd's Bush, London, W. C., England.

Proposed Co-operative Plan of Electrical Distribution in Los Angeles

Addressing the City Council of Los Angeles on Oct. 29, Mr. R. H. Ballard, speaking for the Southern California Edison Company, the Los Angeles Gas & Electric Corporation and the Pacific Light & Power Company, made an important proposition intended as the basis of a plan of co-operation between the companies and the city. The city has in the Los Angeles Aqueduct a source of hydroelectric power, but it has at present no means of distributing this energy. It has been proposed on the part of the city to issue bonds to raise money to build an electric distributing system parallelling the systems of the private companies. The companies now propose to lease their distributing systems to the city with the possibility that the city ultimately may acquire these distributing systems. The details of the proposal made by Mr. Ballard on behalf of the companies have not been worked out; but, subject to the approval of the Railroad Commission of the State of California, the companies offer to lease their distributing systems within the city of Los Angeles to the municipality for a period of ten years.

After the meeting Mr. Ballard is reported to have said to a newspaper reporter that the upshot of his proposal, if it is carried out, would be a 5-cent maximum rate for electricity in Los Angeles by co-operation between the city, with its cheap source of energy, and the companies, with their existing distribution facilities. He said that after the city had paid the companies for the lease of the lines and also paid the expenses of distribution the remainder left from collections for the sale of energy would be more than $900,000 for the first year, increasing to $1,150,000 a year subsequently. If the city should build a duplicate distributing system, its expenditure would be more than $9,000,000 before it could secure 25 per cent of the business, and it would force competition between the city and the companies, resulting in substantial losses to both. If the companies' proposal is accepted by the city authorities and approved by the state commission, it will go to the citizens to be voted upon.

Meeting of the Electrical Manufacturers' Club

The Electrical Manufacturers' Club held its annual meeting at the Homestead Hotel, Hot Springs, Va., during last week. There were fifty members present, making one of the largest meetings ever held by the club. Following the practice introduced a year ago, an address on topics of public interest and concern was made by a speaker of national prominence. Ex-president William H. Taft, who was the speaker this year, read a paper on "Signs of the Times." It will be remembered that one year ago Dr. Charles W. Eliot, president emeritus of Harvard University, delivered an address before the club in which he discussed questions relating to conditions of labor. It has been decided that the club shall have at each annual meeting a similar address by a prominent man.

Mr. Taft's address, which was presented on the evening of Nov. 6, was about 10,000 words in length and required about two hours to present. Mr. S. O. Richardson, Jr., president of the club, who introduced the speaker of the evening, spoke of him as a progressive of a true, not a false, type. In acknowledging this introduction Mr. Taft expressed his amusement and said that there were some places where that portrait of himself would not be recognized. Mr. Taft's address dealt with many of the principles which he enunciated in public addresses during his career as President. As he stated when his term of office as President expired, he felt that he should do all that he could to strengthen the conservative forces in our government. This, in fact, was the main subject of Mr. Taft's remarks. He stated that he feels it to be his duty to carry on a campaign for conservatism in government. He declared that he enjoys being a private citizen and that he is in the position of a man up a tree and can now keep watch on everything. Mr. Taft argued at length against the referendum, declaring that only 16 per cent of the population of the country vote and that one-half of the voters pay no attention to the referendum attached to ballots. This means, he stated, that only a little more than 4 per cent of the population rule. The address touched on various other subjects of general public interest.

The club will follow the same plan with Mr. Taft's address that it did with that given by Dr. Eliot a year ago. It will be published in pamphlet form for circulation. It is stated that the address will be issued in this way in about a month. The publication of the address is in the hands of the prize essay committee, of which Mr. A. B. Houghton, Corning, N. Y., is chairman.

Among the subjects considered by the club was the work of the Society for Electrical Development. Forty-one manufacturers belonging to the club have become members of the society, making an aggregate annual subscription of $80,000 by them for this movement. Other members of the club are considering affiliation with the society. Mr. S. O. Richardson, Jr., in introducing the subject of membership in the Society for Electrical Development, expressed his warm personal indorsement of the movement, and stated that his company, the Libbey Glass Company, joined some months ago. Mr. J. Robert Crouse made a brief address and emphasized the principles of the organization of the

society so far as they relate especially to manufacturers. Mr. Gerard Swope, vice-president Western Electric Company, explained in detail the plan of organization of the society and the balanced representation of the logical great divisions of the industry. He declared that the plan and personnel of the officers and directors give every promise of economical and efficient expenditure in the work. Mr. F. S. Terry, manager National Lamp Works, also addressed the meeting in regard to the results which the society can accomplish. He stated that the result of early efforts in this work in 1906 and 1907 greatly exceeded expectations and indicated that an efficiency in market developments can be obtained by these methods which cannot be secured in any other way.

The annual election of officers of the Electrical Manufacturers' Club resulted as follows: President, Mr. S. O. Richardson, Jr.; vice-president, Mr. Walter Carey; treasurer, Mr. Herbert Sinclair; secretary, Mr. S. O. Richardson III; commissary, Mr. C. I. Hills; members of the board of governors for 1913-14, Messrs. S. O. Richardson, Jr., B. M. Downs, A. H. Pease and A. W. Berresford; members of the board of governors, terms to expire in 1915, Messrs. E. B. Hatch, A. D. Page, S. L. Nicholson and C. H. Wilcox; prize essay committee, Messrs. A. B. Houghton, L. A. Osborne, A. D. Page, L. M. Downes and H. B. Crouse.

New Buildings for Massachusetts Institute of Technology

General plans for the new buildings of the Massachusetts Institute of Technology on the Cambridge Esplanade, fronting the Charles River Basin, at Boston, have been announced. The plans provide for a division of the site, which is more than one-fourth of a mile square, into two parts. On the western portion will be erected the largest educational structure in the world, composed of nine separate but contiguous buildings, each devoted to a separate department of the institute's work. The easterly portion of the site will be devoted to housing of students, athletic and other activities. The buildings will be of white Indiana limestone and of classic architecture and will cost approximately $10,000,000. Nearly 75 per cent of this sum has been pledged in the past two years. They will occupy a site on the basin directly opposite the Back Bay district, and apart from their engineering interest will form one of the most conspicuous architectural groups in America. Unit laboratories and classrooms, a central library with a dome higher than Bunker Hill Monument, drafting room space of 2.5 acres and 20 acres of departmental floor space will be noteworthy features.

Complication in Rate Negotiations in Chicago

After a compromise settlement in the Chicago rate negotiations had been reached on Nov. 6, the committee on gas, oil and electric light of the Chicago City Council upset the arrangement at a subsequent meeting on Nov. 10.

The arrangement governing rates of the Commonwealth Edison Company, which was to have gone into effect under the settlement of Nov. 6, provided that, beginning on Dec. 1, 1913, the rates would be 10 cents per kw-hr. primary, 5 cents secondary and 4 cents tertiary. On March 1, 1914, it was agreed that the rates should be further reduced to 10 cents, 5 cents and 3 cents. The agreement contemplated that the company should contribute $5,000 a year for an electric-service complaint bureau to be established by the city. It was also provided that the company should supply 12,000-volt, three-phase, 60-cycle energy for street lighting to be delivered at the Sanitary District terminal station at West Thirty-first Street and Southwestern Avenue for a primary charge of $1.25 per kw per month and a secondary charge of 0.4 cent per kw-hr. for energy consumed. Other rates were provided for energy delivered to any substation in the city of Chicago for subway lighting and for city buildings, and it was further provided that where the company furnished arc-lighting service the rate should not be greater than $75 per lamp per year for all-night lamps equivalent in illuminating value to the flame-arc lamps now used by the city and taking 465 watts per lamp.

At the meeting on Nov. 6 the committee ordered the ordinance printed. The plan was to introduce the ordinance in the Council on Nov. 10, if possible, as it was desired to obtain speedy action before the Public Utilities Commission of Illinois goes into office on Jan. 1. It was expressly provided in the ordinance that the rates were adopted subject to possible modifications by the State Commission to be appointed or a court review of the commission's findings.

At the meeting of the committee on Nov. 10 one of the members of the committee, Alderman M. J. Healy, who has been identified with the electrical workers' unions, offered an amendment providing that the company should pay the established organized-labor wages for any construction work that might be done in extending street-lighting service for the city. The aldermen who were present voted unanimously for the amendment. Alderman Merriam moved that the term of the contract, which was fixed at five years in the ordinance, be changed to two years. Mr. Ray Palmer, city electrician, protested against this and deplored obstructive tactics at the eleventh hour, but nevertheless the Merriam amendment was accepted. These changes made a patchwork measure that satisfied nobody, and so, when the question came up on the adoption of Section 1 of the proposed ordinance, as amended, the committee refused to adopt the section. This was tantamount to striking out the enacting clause and left the whole result of eighteen months' work in the air. Mr. William H. Arthur, attorney, and Mr. W. J. Norton, rate expert, represented the company, but had little to say as the committee struggled with the difficulties of the situation. Leaving the matter in this unsatisfactory way, the committee adjourned to meet again within a few days.

To Encourage Use of Water-Power in Georgia

The Georgia Chamber of Commerce has appointed a committee on water-power development whose purpose is to enlighten the farmer on the uses of electricity in agriculture, to reach out after manufacturers of other states, and to show the possibilities of irrigation as applied to intensive farming. In order to secure the active co-operaton of the people of the State in the movement, the committee points out some of the fallacies regarding hydroelectric developments which prevail among the uninformed. Many citizens have been led to believe that water-power is a means of getting from nature something for nothing. This, the committee shows, is a mistaken idea, for it costs vast sums to harness the water-powers of the State; interest must be paid on this money; dividends must be returned to those who have hazarded their fortunes to make possible this cheap power; machinery must be renewed, and transmission lines must be kept up to the end that the citizens can enjoy these great benefits.

The committee on water-power and water-power development has as its head Mr. Charles F. Howe, a consulting engineer of Macon, who has been connected as chief engineer with the development at Jackson owned by the Central Georgia Power Company. Associated with Mr. Howe are Messrs. S. W. McCallie, State geologist, Atlanta; B. M. Hall, consulting engineer, Atlanta, who has been employed by the government on irrigation projects and water-

power development in the West and Porto Rico; Paul Norcross, Atlanta, of the Solomon-Norcross Company, hydraulic engineers; G. F. Harley, Columbus, hydraulic constructing engineer; W. A. Carlisle, Gainesville, who has been closely identified from its inception with the North Georgia Electric Company and the Georgia Power Company; Nisbet Wingfield, Augusta, who as city engineer has had charge of the water-powers of that city and the construction of the great dike to protect the city from flood water; Charles A. Caldwell, the well-known engineer of Macon; C. D. Flannigan, Athens, another pioneer of water-power development in Georgia, together with a number of other gentlemen equally well known and specialists in their line.

It is expected that this committee will endeavor to its utmost to foster the interests of Georgia through the use by its citizens of the water-powers at hand, as well as in inducing manufacturers and capitalists to come from other states.

Hydroelectric Energy on New York Canals

Mr. George Clinton, of Buffalo, read a paper before the New York State Waterways Association at Albany on Oct. 30 on the subject "State Generation of Hydroelectricity." He declared that experience had shown that when the government entered upon the province of private enterprise it always involved great injury to private investment and infraction of private legal rights or tremendous cost to acquire those rights. The production and furnishing of hydroelectric energy by the State, particularly under the circumstances existing in New York, will work great injustice, Mr. Clinton said, to the general taxpayer, while in every instance the benefits will accrue to limited localities. There is no place upon the canals of New York State, Mr. Clinton added, where surplus water can be obtained and utilized without the expenditure of very large sums of money by the State, and there is no place east of Rochester where it is at all certain that there will be any surplus waters that can be utilized with any regularity for the production of electricity except at locks, where electricity sufficient for the use of the canal and nothing else can be produced.

Annual Dinner of Commonwealth Edison Company Section

Perhaps the most prominent feature of the "get-together" activities of the Commonwealth Edison Company in Chicago is the annual dinner of the company section of the National Electric Light Association. The sixth gathering of this sort was held on the night of Nov. 6 at the Hotel Sherman and was attended by about 650 men. The occasion was notable by reason of the presence of a number of gentlemen connected with other public utilities of Chicago with which the Commonwealth Edison Company is now closely associated. Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company, presided at the dinner as the retiring president of the section.

Mr. Samuel Insull, in a serious address, made the point that the people own the corporations and that this widespread ownership is increasing. In this fact lies the hope that unfair attacks on corporations as such will cease. The electrical industries felt the effect of dear money during the last year less than other industries. Perhaps this was due to the facts that they are officered by young men, that they have seen the handwriting on the wall of public opinion as affecting corporations, and that they have to some extent made their arrangements to bow to public opinion. Mr. Insull remarked that the membership of the section is now 1750, which is more than 10 per cent of the membership of the National Electric Light Association and 40 per cent of the eligible employees of the Commonwealth Edison Company. He praised highly the work of the National Electric Light Association, told again what the service-annuity plan means to the employees of his company, dwelt on the importance of the employees' savings fund, and concluded with an earnest exposition of Commonwealth Edison service, which is represented by the service badge.

Mr. J. F. Meagher, president of the People's Gas Light & Coke Company, made a witty speech in which he mocked at the technical terms of the electric-service industry and the primary and secondary and even tertiary charges, which he cited as dazzling examples. Mr. Abbott made a report of the year's work of the section and introduced the new chairman, Mr. F. J. Arnold, of the engineering department, who spoke briefly. The other newly elected officers of the section are Mr. P. J. Smith, of the arc-lamp and sign department, vice-president, and Mr. T. J. Walsh, of the statistical department, secretary. Mr. William A. Fox has been re-elected as treasurer. During the evening the Commonwealth Edison Orchestra, under the leadership of Mr. M. L. Eastman, gave some high-class music. An excellent minstrel show was given by the Glee Club of the company under the management of Mr. Harold Wright.

Varied Work of Electrical Inspectors

Mr. Victor H. Tousley, chief electrical inspector of the city of Chicago, gave a talk at the luncheon of the Chicago Jovian League on Nov. 10. Mr. E. H. Waddington presided. Mr. Tousley described in an interesting manner the work performed by the Bureau of Electrical Inspection of the Department of Electricity of the city of Chicago. By a recent city ordinance all electrical contractors must be registered before receiving a permit to do electrical construction work. This ordinance went into effect on Oct. 1, and since that date 548 contractors or electricians have registered themselves with the bureau. The inspection fees of the bureau this year will amount to about $200,000. The bureau has sixty-seven employees and it is operated at a profit to the city. However, it is planned to expend any surplus in bettering and extending the service. One interesting fact mentioned by the speaker in giving statistics of inspections was that the average rating of electric motors in the city of Chicago is about 9 hp.

Concentration of Energy Production in Chicago

Practically all the energy requirements of the surface and elevated railway companies of Chicago are now supplied by the Commonwealth Edison Company. Recently three of the old elevated railway generating stations have been taken over by the central-station company—the Fullerton Avenue station of the Northwestern Elevated Railroad Company, the Loomis Street station of the Metropolitan West Side Elevated Railway Company and the Fortieth Street station of the South Side Elevated Railroad Company. The station-operating forces of the elevated-railway companies have been incorporated into the operating department of the Commonwealth Edison Company, including Mr. A. L. Hadin, operating engineer of the Chicago Elevated Railways. It is probable that eventually all of the railway generating stations will be shut down, although some of them, notably the South Side company's station, have an excellent record of economy. Five "straight railway" substations have been taken over by the substation department of the Commonwealth company.

As the Cosmopolitan Electric Company has been absorbed by the Commonwealth Edison Company, its modern Grove Street generating station and its two substations, one at the Stockyards and the other downtown, are now oper-

ated by the Edison organization, into which the 240 employees of the Cosmopolitan Company have been taken. It is of interest to note that when the two companies were consolidated and the papers were filed with the Secretary of State at Springfield, an incorporation fee, as though a new company had been incorporated, was required. This fee amounted to over $50,000.

The highest total-output maximum of the Commonwealth Edison Company up to Nov. 1, 1913, was 257,830 kw on Oct. 31, 1913. The highest peak of last Winter was 232,950 kw on Dec. 11, 1912. It is estimated that this winter's total-output maximum will be about 300,000 kw. The highest twenty-four-hour kilowatt-hour output up to Nov. 1 of this year was 3,365,900 kw-hr. and was recorded on Oct 30, 1913. It is probable that the maximum day's output for this winter will be 3,700,000 kw-hr. or over.

The number of employees on the pay-roll of the Commonwealth Edison Company on Nov. 6, 1913, was 4713. This large number is accounted for not only by the additions from the Cosmopolitan and Elevated Railway Companies but by the large amount of construction work the company is doing.

Decision Upholding Emmet Patent for Sectional Blade-Tie for Steam Turbines

A decision has been handed down by Judge Hazel in the United States District Court for the Western District of New York, at Buffalo, upholding the validity of the Emmet patent, No. 924,546, issued June 8, 1909, for an improvement in steam turbines consisting of a sectional blade-tie riveted to the buckets by means of tenons integral therewith. The complainant was the General Electric Company, assignee of Mr. W. L. R. Emmet's patent just mentioned, and the defendants were the city of Dunkirk, N. Y., and the Board of Water Commissioners of that place, which had in use an alleged infringing turbine manufactured and installed by the Allis-Chalmers Company.

The construction of the Emmet sectional blade-cover is shown in Figs. 1 and 2, which are self-explanatory. The object was to overcome the excessive centrifugal stresses in prior covers or rings and to prevent leakage of steam, as well as to stiffen and strengthen the blades themselves. The defences advanced against the charge of infringement

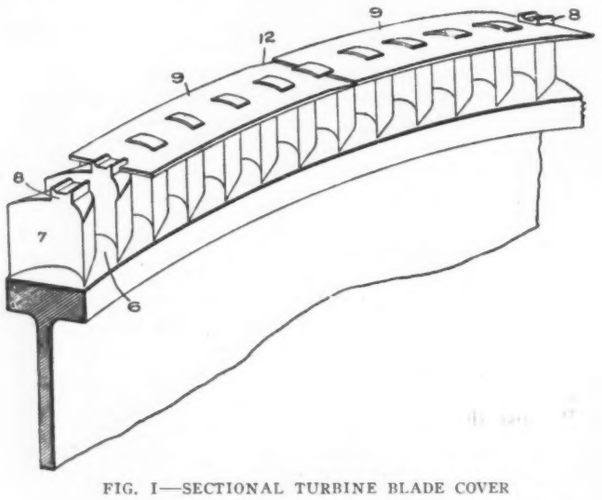


FIG. 1—SECTIONAL TURBINE BLADE COVER

were want of novelty and invention, anticipation, and non-infringement. While cover plates or rings were old, the opinion held that Emmet was the first to use tenons for rigidly fastening the cover plate to the vanes, and by a combination of old and new elements advanced the art. The tie blades and the rings or shrouds of the prior art were difficult of manufacture owing to their bore, their thinness, and their notches making connection with the blades. These continuous rings or shrouds were impracticable in high-power motors and lacked complete efficiency as a means for strengthening the blades.

According to the patent law, the inventive faculty resides in the reduction of an idea to practice as distinguished from merely making mechanical alterations, and whenever an

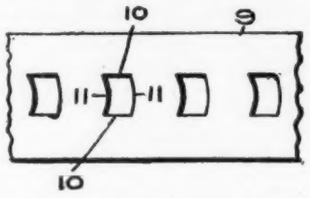


FIG. 2—DETAIL OF RING

old device is put to a new use and produces a new result, a question of fact arises over whether such older adaptation would occur to a person of ordinary mechanical skill.

The defendants introduced in evidence the file wrappers of the Fullager patents, No. 696,867, issued April 1, 1902, and No. 746,061, issued Dec. 8, 1903, and although numerous other patents were cited as disclosing the Emmet construction at earlier dates, the greatest emphasis was placed on these two patents mentioned. It was under these patents that the infringing turbine was manufactured. These patents were involved in complicated interference proceedings with Emmet's patent, since they involved claims for similar construction. Although the interference proceedings were all finally dissolved, conflicting views as to priority were held in the Patent Office and as to the exercise of diligence in reducing the Emmet invention to practice. The court stated that in view of the new testimony before it, the exercise of independent judgment became necessary. In short, the court held that Emmet exercised all necessary diligence in reducing his invention to practice, and this, taken with his oath as to conception of invention before the Fullager filing date, in the court's judgment upheld him as the legal inventor. The complainant was therefore awarded a decree with costs.

Chicago Electric-Vehicle Situation in 1913

At the meeting of the contract department of the Commonwealth Edison Company on Nov. 11 Mr. R. Macrae read a paper on the present electric-vehicle situation in Chicago, with which the author is thoroughly familiar. Few persons, he said, realize the rapid rate at which horses are disappearing from the streets of Chicago. Applications for energy to operate mercury-arc rectifiers are being received by the company at a rate that would call for the work of fifty or sixty horses a month. As only about 20 per cent of the electric vehicles in Chicago are charged from rectifier outfits, it is fair to assume that electric vehicles are now displacing horse-drawn vehicles at a monthly rate corresponding to the work of 300 or 400 horses.

Mr. Macrae, who is a man not given to over-confidence, predicted that vehicles operated by electricity will ultimately displace all other kinds of vehicles for city street traffic unless some very radical improvements are made in the other vehicles. He exempted touring and racing cars, referring to commercial and pleasure vehicles for city use. It is true that conditions are not now favorable in all cases in cities for the operation of electric vehicles, but they are slowly becoming more favorable. On this point, referring specifically to the situation in Chicago, he said:

"With electric light streaming from every window and cars shooting by in every direction and picking up electric

power almost for nothing as they go, the electric truck has sometimes to travel 10 miles to get a little charge of electricity. We may, however, expect that a change for the better will soon be brought about in these conditions, now that everyone seems to be convinced that the electric vehicle has come back to stay."

Superlative claims of salesmen in relation to the simplicity of operating electric vehicles have probably been responsible for many electric-vehicle failures. An electric vehicle requires special attention which must be given to it by a person who not only knows what to do but also has the facilities for doing it. Mr. Macrae agreed with the statement that the wear and damage to an electric vehicle usually occur not on the streets but inside the four walls of a garage. In relation to the charging of batteries in unattended garages Mr. Macrae remarked that automatic apparatus is all right provided it is used under the supervision of some one who knows when it is working properly, but such devices can never take the place of intelligence on the part of the person who is looking after the vehicle. The expression "unattended garage" should be used with caution in discussing the electric-vehicle problem, because it may easily imply neglect.

Experience has shown that commercial electric vehicles operated in fleets are always a success; operated singly they are often a failure. In the one case they are properly cared for; in the other they are usually neglected. In advising its customers the central-station company should point out that the electric vehicle, to be a success, should be cared for intelligently and operated as an electric vehicle and not in the way a horse-drawn or gasoline vehicle is operated.

Following the reading of his paper Mr. Macrae exhibited a number of lantern-slide pictures. A composite load curve made up of the averages of six public garages showed that there was little consumption of energy from 8 a. m. until noon, almost none from noon until 8 p. m., and that the maximum occurred at 2 a. m. This is exactly the kind of load the central station needs. In relation to the mercury-arc rectifier used in vehicle battery charging Mr. Macrae described Chicago as a rectifier town. This no doubt is due to the fact that so large a proportion of the area of the city is served by alternating current. It is reported that the General Electric Company sells more rectifiers from its Chicago office than from all its other offices put together. The speaker reported that the operating company has had little trouble with rectifiers, particularly in the smaller sizes. The tube is the best kind of a protective device. While it is buzzing away the vehicle owner or the garage proprietor may rest assured that everything in the charging process is going along all right. There are over 550 mercury-arc rectifiers on the circuits of the Commonwealth Edison Company, and Mr. Macrae has never heard of a serious complaint.

Figures were given to show that the average cost per mile of the electric delivery service of the Commonwealth Edison Company, considering the results obtained with a fleet of fifty vehicles, is 25.1 cents. Of this amount 9.3 cents is for operating and repairs and 2.4 cents for electrical energy used in charging the batteries. The cost of this energy is figured at 4 cents per kw-hr, which is twice as much as an outside consumer could buy it for under the most favorable conditions. The cost per mile for operating a corresponding horse-drawn vehicle in the Commonwealth Edison Company's service is 31.2 cents. A load curve was given showing that the average demand of twenty private garages was 142 kw-hr. per month. The speaker concluded by saying that better garaging facilities constitute the immediate need of the electric-vehicle situation in Chicago.

Mr. E. W. Lloyd presided at the meeting and he and Mr. George H. Jones spoke briefly. About 125 men attended the session.

Ozone Machines and Public Health

"The Alleged Purification of Air by the Ozone Machine" is the title of a recent article in the *Journal of the American Medical Association* reporting experiments on the bacteriological and physiological effects of commercial ozone machines, conducted by the authors, Dr. W. A. Sawyer, director of the Hygienic Laboratory of the California State Board of Health, Berkeley; H. L. Beckwith and E. M. Skolfield.

Although the work of many careful investigators has discredited ozone for the purification of air, assert the authors, the purposeful adulteration of the air in public buildings by the use of ozone machines now threatens to become a public health problem. Ohlmüller showed that ozone was incapable of killing dry bacteria, and Erlandson and Schwartz demonstrated that the presence of ozone does not insure the absence of organic impurities, although for the time masking obnoxious odors. Filipow proved that ozone concentrated irritates the mucous membranes. Hill and Flack showed that one part per million irritates the respiratory tract, while two hours' exposure to fifteen or twenty parts per million might endanger life.

The experiments made by the authors utilized two well-known ozone machines and were conducted to show the relative killing power for animals and bacteria. A tight wooden cabinet, with a volume of 33 cu. ft., and a carefully closed room of 730 cu. ft. were used. Bacteria cultures were grown in meat broth and dried on sterile glass rods which were introduced into the ozone-filled cabinet. Guineapigs placed in the compartment died at intervals of one and one-half to four hours after the ozone machine had been started. Death was caused by marked edema of the lungs, which were found filled with foamy liquid. One guineapig, for example, showed labored breathing at the end of twenty minutes. Five minutes later it began rubbing its nose with its forefeet. At the end of forty-five minutes it was drowsy and at the end of one hour its eyes were watery and almost closed. Half an hour later its breathing was spasmodic and there were convulsions. In one hour and forty minutes after starting the ozone machine the animal was struggling for breath, and fifteen minutes later it died.

In all instances the streptococcus and staphylococcus cultures showed organisms of the characteristic morphology, and in every test in which guineapigs and bacteria were in the cabinet together the bacteria outlived the guineapigs. While working about the machines the experimenters declare that they themselves noticed a feeling of dryness or "tickling" in the nasopharynx accompanied by watering of the eyes and headache after prolonged exposure. From their experiments they conclude:

1. The products of the two well-known ozone machines examined are irritating to the respiratory tract and, in concentration, will produce edema of the lungs and death in guineapigs.

2. A concentration of the gaseous products sufficiently high to kill within a few hours such bacteria as typhoid bacilli, staphylococci and streptococci, dried on glass rods, will kill guineapigs in an even shorter time. Such products, therefore, have no value as bactericides in breathable air.

3. Because the products of the ozone machines are irritating to the mucous membranes and are probably injurious in other ways, the machines should not be allowed in schools, offices or other places in which people remain for considerable periods of time.

4. The ozone machines produce gases which mask disagreeable odors of moderate strength. In this way the machines can conceal faults in ventilation while not correcting them. Because the ozone machine covers unhygienic conditions in the air and at the same time produces new injurious substances, it cannot properly be classed as a hygienic device.

Public Service Commission News

Indiana Commission

The strike of employees of the Indianapolis Traction & Terminal Company, the impending difficulties of employees of the interurban railways, the strike of electrical linemen in Indiana and the strike of local carmen at Richmond, Ind., have thrown new burdens on the commission. Governor Ralston points out that the commission was called into the street railway difficulty only because a crisis had arisen and not with any intention of placing the additional burdens of labor troubles regularly upon the commission. That such a turn should be given the duties of the commission is preposterous, he said. Under the terms of the agreement, the employees and the company officials appeared before the commission at the expiration of five days after the agreement was signed with their differences over wages, hours, conditions of labor and other subjects and the commission began the task of arbitration. The decision of the commission, to be given in thirty days, was to be binding for three years on both parties. The present situation, in which the Public Service Commission is seen acting as a labor arbitration board, will be remedied, according to the Governor's statement, as soon as the Legislature can meet. Then an arbitration board probably will be created.

The Terre Haute Commercial Club has presented three petitions for an investigation of rates and valuation of the Terre Haute, Indianapolis & Eastern Traction Company, which supplies electric power and lighting and heat; the Citizens' Gas & Fuel Company and the Terre Haute Water Works Company. The petition in reference to the traction company declared that the schedule of rates filed with the commission by the company on July 29, 1913, showed excessive and unreasonable rates and discrimination. It also contended that certain regulations now in force by the company were in violation of the Indiana law. Among these regulations were one prohibiting customers of the heating plant from using other illumination than that supplied by the company, a provision that all electrical consumers shall pay a minimum meter charge, a provision that the maximum demand on which rates and charges are based shall be deemed to be the total connected load of the consumer's equipment, and a provision giving different rates to consumers who use the company's service exclusively. The petition also charged that the traction company does not maintain the voltage agreed upon or consistent with the equipment of consumers.

The commission may be forced to take some other course than to make physical valuations, because of the lack of the facilities for carrying on extensive work of this character, owing to the small engineering force and funds available.

Massachusetts Commission

The Edison Electric Illuminating Company of Boston has filed an appeal with the Gas and Electric Light Commission against the Board of Aldermen of Chelsea, which recently granted a franchise to the firm of A. G. Walton & Company to erect wires along the streets in the vicinity of its factory for local electrical distribution.

The Massachusetts Gas and Electric Light Commission has issued its report for the calendar year 1912, including returns for the fiscal year ended June 30, 1912. The report is one of the longest ever issued by the board, covering 717 pages of material bearing upon legislation, decisions, special reports, accidents, meter testing, price cases, security issues, statistics and other related topics. Returns were made to the board from sixty-eight incorporated gas companies, fifty-six incorporated electric-light companies and twenty persons or associations making or selling electricity or gas. Thirty-two municipal plants also filed returns. Four new electric service companies were incorporated during the year. The work of the board in smoke abatement has proceeded steadily, and thus far but one formal hearing as a prerequisite for court proceedings for violation of the Massachusetts smoke law has been found necessary. The commission points out that the law can be enforced without hardship to plant owners and with increased economy of operation. A valuable feature of the appendix is a special report of the board upon demand meters which was made to the Legislature last year upon the request of the latter in connection with a proposition to regulate or prohibit the use of such instruments. As reviewed in these columns at the time, the report contains a large number of engineering data of interest and the conclusion of the board that its supervisory authority should be extended over apparatus of this character.

The commission's summary of financial conditions in the central-station industry of the State evidences continued rapid growth in the popularity and success of electric service. The total income of the private electric-service companies for the fiscal year 1912 was $13,580,031, compared with $12,353,109 in 1911. Income from the sale of energy for commercial lighting increased from $7,167,569 to $7,914,368, and income from its sale for industrial purposes from $2,677,425 to $3,023,512. Operating expenses, taxes and administrative costs were $7,976,348, compared with $7,251,118 in 1911, and dividends were $2,934,448 in 1912, compared with $2,662,703 in 1911. The companies' net profit for the year, after all fixed charges were deducted, came to $232,587 as against $166,966 in the previous year. The assets for 1912 were $56,824,843, compared with $51,327,024 in 1911, and the surplus for 1912 was $2,263,813, compared with $2,049,081 in 1911. The actual surplus is stated as 13.27 per cent of the capitalization for 1912, compared with 11.76 per cent for 1911.

Illinois Commission

Mr. Richard Yates has been appointed a member of the Railroad and Warehouse Commission of Illinois. This board will go out of existence on Dec. 31, 1913, and will be succeeded by the Public Utilities Commission of Illinois. It is considered probable, therefore, that Mr. Yates will be appointed a member of the new commission. The law provides that not more than three of the five members of the new commission shall belong to any one political party. The present administration of Illinois is Democratic. Mr. Yates is a Republican and was Governor of Illinois from 1901 to 1905.

Oregon Commission

The Railroad Commission of Oregon has issued a uniform classification of accounts for electric, gas and water utilities. The classification was adopted June 16, 1913, and became effective on July 1, 1913.

The instructions pertaining to the accounts define repairs, which are to consist of ordinary and extraordinary repairs. Ordinary repairs are not required to be taken into account in fixing a rate of depreciation. Extraordinary repairs should be provided for by adequate charges to depreciation.

The instructions also state that utilities should include in operating expenses depreciation charges for the purpose of creating proper and adequate reserves to cover the expenses of depreciation currently accruing in the tangible fixed capital. The amount charged as expense of depreciation should be based upon rules determined by the utility. Utilities should be prepared to give to the commission upon demand the rules and a sworn statement of the facts, expert opinion and estimates upon which they are based. The rate of depreciation should be fixed so as to distribute, as nearly as may be, evenly throughout the life of the depreciating property the burden of extraordinary repairs and the cost of capital consumed in operations during a given month or year and should be based upon the average life of the units comprised in the respective classes of property.

In referring to "extraordinary casualties and unanticipated reconstruction" the instructions state that, if so

authorized, upon application to the commission the utility to which such authority is granted may charge the amount named in the authorization to an expense account for the purpose of distributing over a limited period a loss of such a nature that it cannot be anticipated by the exercise of reasonable prudence.

For the purpose of the system of accounts the utilities are divided into three classes, those with gross annual revenues exceeding $100,000, those with revenues exceeding $25,000 but not more than $100,000, and those with $25,000 or less.

Current News Notes

COMFORT FOR DUMB ANIMALS PROVIDED ELECTRICALLY.—The owner of a stable in Louisville, Ky., realizing the impossibility of obtaining good service from his horses when they were constantly annoyed by flies, placed a large electrically driven canvas paddle over each stall. All the fans were attached to a long shaft turned by a single electric motor.

* * *

GUIDE TO NATIONAL ELECTRICAL CODE CHANGES.—The Philadelphia Fire Underwriters' Association has issued a guide to the changes in the National Electrical Code, edition of 1913. This pamphlet was prepared with a view of affording wiremen a ready means of ascertaining what changes and additions have been made to the old code. By this means it is believed electrical contractors will have little or no trouble in complying with the provisions of the present edition of the National Electrical Code.

* * *

COST OF SERVICE VERSUS VALUE OF SERVICE.—In holding that a certain increase in freight rates was justified the Interstate Commerce Commission laid down on Oct. 28 the following general principle of great significance in rate making: "If, when viewed in the light of those considerations which enter into proper rate making, a particular rate is fair and just for the service performed, the price at which the shipper markets his product cannot be accepted as the controlling factor in fixing the rate."

* * *

ELECTRIC SEARCH-LAMPS IN COLORADO STRIKE.—As a result of the recent labor troubles in the Colorado mining districts, twenty-one electric search-lamps have been purchased by several mine owners and are being used for detecting hostile movements in the vicinity of the mine properties. Most of the lamps have 18-in. reflectors, although the largest is a 30-in. projector. All are of the pilot-house-control type, being mounted on top of, and controlled from, a sheet-steel cabinet in which the operator is stationed.

* * *

LOS ANGELES MUNICIPAL LIGHTING PLANT ACTIVITIES.—The city of Los Angeles, Cal., is now agitating the establishment of a municipal electric lighting plant and the operation of the lighting system from energy obtained from a plant built in connection with the new aqueduct system. The City Council recently appointed a board of engineers to advise the city as to the probable cost and probable earnings of a municipal distribution system. The members of this board are Dr. George L. Hoxie, of New York; Prof. C. L. Cory, of the University of California, and Mr. C. F. Koiner, of Pasadena.

* * *

GRAND JUNCTION, COL., REJECTS MUNICIPALIZATION PLANS.—Voters of Grand Junction, Col., rejected on Nov. 4 three separate proposals for municipalization of local public utilities. One question upon which a vote was taken was the purchase or construction of an electric plant, another involved the purchase or construction of a gas plant, and a third proposed the purchase of the gas, electric and railway properties of the Grand Junction & Grand River Valley Railway Company. The largest vote was recorded in opposition to the proposed municipalization of the Grand Junction & Grand River Valley Railway.

* * *

FREE LECTURES ON ELECTRICAL ENGINEERING.—A course of lectures on electrical engineering is being given by Mr. W. Wallace Ker, of the Hebrew Technical Institute, at St. Bartholomew's Lyceum Hall, 205 East Forty-second Street, New York, under the auspices of the New York Board of Education. The lectures, admission to which is free, are as follows: Nov. 15, "The Electric Storage Battery"; Nov. 22, "Alternating Currents of Electricity"; Nov. 29, "Development of Electricity and Its Use at Niagara Falls"; Dec. 6, "The Steam Turbine"; Dec. 13, "Primary Batteries."

* * *

RADIO STATIONS OF THE UNITED STATES.—A list of the land and ship radio stations of the United States has been printed by the Department of Commerce, Bureau of Navigation, Washington, D. C. The contents include a list of land stations arranged alphabetically by names, a list of all ship stations, and a list of all United States call signals arranged alphabetically, each followed by the name of the ship or land station to which the call has been assigned. In Part II is given a list of amateur stations licensed up to June 30, 1913, arranged according to radio districts, with the headquarters and territorial limits of each district. Copies of this publication may be procured from the Superintendent of Public Documents, Washington, D. C., at 15 cents each.

* * *

FOREIGN WEIGHTS AND MEASURES.—The Foreign Trade Bureau of the Philadelphia Commercial Museum, Philadelphia, Pa., has issued a sixty-four-page pamphlet giving conversion tables of foreign weights, measures and money and also comparisons of prices per pound, yard, gallon or bushel in United States money with prices per kilo, meter, liter, hectoliter, etc., in foreign money. The pamphlet is compiled by the librarian and statistician of the museum, Mr. John J. Macfarlane. This publication will be found of value to manufacturers in the United States who have already established commercial relations with other countries, and it contains useful suggestions to those planning to enter into trade with foreign countries. Mr. Dudley Bartlett is chief of the Foreign Trade Bureau of the Philadelphia Commercial Museum.

* * *

PHYSICAL RESEARCH.—The investigations carried out by the Physical Laboratory of the National Electric Lamp Association, Cleveland, Ohio, the results of which have been presented before various scientific and technical societies of the United States, are published in the "Abstract-Bulletin," issued by the firm. In the first issue published abstracts are given of articles relating to every research carried out in the laboratory from its inception in 1908 to the summer of 1912. This publication contains papers by Dr. Edward P. Hyde, Dr. Herbert E. Ives, Mr. M. Luckiesh, Mr. F. E. Cady, Mr. A. G. Worthington and Dr. Percy E. Cobb. Some of the complete papers of which abstracts are made have been presented before the Illuminating Engineering Society and the American Physical Society, while others have appeared in the *Electrical World, Electrical Review and Western Electrician, Astrophysical Journal, American Journal of Physiology, Physical Review, Philosophical Magazine,* and *Illuminating Engineer.* The pamphlet contains 128 pages and is fully illustrated with photographs and drawings. The information given is valuable, and the abstracts, which have been prepared by the authors themselves, will serve their purpose well for all those who desire a general knowledge of the latest researches on the subjects treated.

Prussia to Develop Hydroelectric Energy.—A law has been enacted in Prussia to provide a sum of about $2,500,000 for the development of hydroelectric energy by the State from existing reservoirs built by the government, in connection with the Rhine-Hanover Canal, at Hemfort, on the River Ader, and at Helminghausen, on the River Diemel. It is proposed, further, to connect the plants to be erected at these points with a third station at Munden, on the Rivers Fulda and Werra. The total rating of the stations will be 41,000 kw. The area to be served includes thirteen counties in Prussia and three in Waldeck with a population of 600,000. The energy will be distributed to fifteen points in this area by a 40,000-volt system about 215 miles long, and at each point there will be a transformer station to reduce the voltage to 6000.

* * *

Water-Powers in New Quebec.—In bulletins published by the Department of Colonization of Mines and Fisheries in the District of Ungava, recently added to the Province of Quebec, under the name of the territory of New Quebec, a vast amount of information is obtainable respecting the water-powers of that territory. The interior of Ungava is a huge plateau which rises somewhat abruptly within a few miles of the coast line to a height of from 1500 ft. to 2500 ft. The various streams, therefore, afford numerous water-powers. On the Great Whale River within 20 miles of its mouth there are three falls of 150 ft., 230 ft. and 65 ft. respectively. On the South Branch of this same river a few miles from its mouth a fall of the river gives 136 ft. Nastapoka Falls, near the coast, is 170 ft. in height. Near Richmond Gulf the Wyachuan River Falls possess a head of 315 ft. A remarkable case of very high waterfalls in the interior is that of the Hamilton River. The Grand Falls of this river are situated about 300 miles from Rigolet. The falls themselves have a sheer drop of 302 ft., and for 12 miles above the falls the river rises rapidly so that in that distance the difference of level, including the falls proper, is 760 ft. The discharge is estimated at 50,000 cu. ft. per second, which would give approximately 1,500,000 hp at the fall proper and 3,660,000 hp for the 12 miles of falls of the river. These evidently are flood-water figures, since the Commission of Conservation gives the estimated horse-power of the falls at 120,000 hp, and of the total fall for a distance of 12 miles as 300,000 hp on low-water drainage.

* * *

SOCIETY MEETINGS

Meeting of New York Sections of I. E. S. and N. E. L. A.—The regular monthly meeting of the New York Section of the Illuminating Engineering Society is to be held in conjunction with the New York Companies' Section of the National Electric Light Association at the Edison Auditorium on Nov. 17. Addresses will be made by Mr. S. G. Rhodes, of the New York Edison Company, on "Street Lighting Abroad," and by Mr. H. W. Jackson, of the General Electric Company, on "Recent Developments in Incandescent Electric Lamps." A feature of the evening will be the demonstration of neon tube lighting.

* * *

Convention of Southeastern Section, N. E. L. A.—The 1914 convention of the Southeastern Section of the National Electric Light Association is to be held Aug. 19 to 21, 1914, at the Isle of Palms, a popular beach resort 12 miles north of Charleston, S. C. At a meeting of the executive committee of the section at Charleston last week Mr. C. M. Benedict, treasurer of the Charleston Consolidated Railway & Lighting Company, was appointed chairman of the entertainment committee, the other members of which are Messrs. E. C. Deal, Augusta, Ga.; R. L. Lindsey, Durham, N. C., and W. W. Fuller, Charleston, N. C.

Chicago Section, I. E. S.—"Street Car Lighting" was the subject of a paper presented by Mr. L. C. Porter, of Harrison, N. J., before the Chicago Section of the Illuminating Engineering Society, Nov. 12. Preceding Mr. Porter's paper, Mr. W. A. Durgin, Chicago, gave a twenty-minute talk on "Fundamentals of Illumination." The next meeting of the Chicago Section, "ladies' night," will be held Dec. 10 at the residence of Mr. A. D. Curtis, 5528 East End Avenue, Chicago. Mr. Curtis will read a paper, "Five Years' Progress in the Indirect Lighting of the Home." At the session scheduled for Jan. 28 Mr. J. B. Jackson will present a paper on "Planning Lighting Installations."

* * *

Meeting of Yonkers Section, N. E. L. A.—The first monthly meeting of the N. E. L. A., Yonkers Section, was held on Nov. 10. Mr. J. P. Radcliff, who acted as temporary chairman, introduced Mr. W. I. Donshea, who explained in detail the workings of the new amendment to the constitution which provides for the local meetings of the different companies. Mr. Donshea also gave an interesting talk on the prizes to be awarded by the N. E. L. A. for the best papers submitted and urged the members not to be slow in the presentation and discussion of papers. Mr. G. B. Cornell, Jr., was elected permanent chairman for the coming year and Mr. E. J. Reilly was elected secretary. Mr. Cornell read a very interesting and instructive paper on "Electricity on the Farm," by Mr. E. P. Edwards, of the General Electric Company, illustrated with lantern slides. This is one of the lectures furnished by the lecture bureau of the N. E. L. A. The Rev. F. W. Cutler also delivered a very interesting talk, his subject being "Co-operation and Organization." A pleasing feature of the evening was the presentation of a silver loving cup by the employees of the Yonkers station to Mr. B. O. Fuller, who recently resigned as inspector to accept the position of superintendent of the Hollywood Inn.

* * *

Touring in the Electric Automobile.—At a well-attended meeting of the Chicago Section of the Electric Vehicle Association on Nov. 4 Col. E. W. M. Bailey, who recently toured from Boston to New York and thence to Chicago in a Bailey roadster, was the guest of honor. He gave an interesting description of his trip and there was an informal discussion by the representatives of manufacturers of electric vehicles and storage batteries as well as garage men and central-station men. Colonel Bailey said that too much stress should not be laid on making long runs on one battery charge. It is better to encourage the establishment of facilities for charging at frequent intervals along main-traveled highways. It is true, he said, that the Edison battery is best adapted for a trip such as he made inasmuch as it can be rapidly charged and discharged. Nevertheless, there is a large field for the lead battery in the equipment of city cars. Another point made by the speaker was that the average running speed of gasoline cars in touring trips is not more than 18 or 19 miles an hour. All present seemed to be much interested in the possibilities of electric automobile touring, and it was the general opinion that with suitable types of electric cars the possibilities of cross-country runs have been but little appreciated. Some of the storage-battery men said that with the existence of charging stations not too far apart, with the proper car and perhaps with some improvements in the battery itself, the lead battery will not be excluded from the equipment of electric touring automobiles. The opinion was expressed that all interested in the advancement of the electric passenger vehicle should take a greater personal interest in making touring trips in electric machines, seeing to it that the public is acquainted with the results. It was thought that the New York-Chicago trip of Colonel Bailey will be of distinct benefit to the industry.

Hydroelectric Development on the Tennessee River

Completion of Hales Bar station of Chattanooga & Tennessee River Power Company after nine years of work—Difficulty encountered in building dam

ON Thursday of this week, Nov. 13, the largest single hydroelectric development in the South, that of the Chattanooga & Tennessee River Power Company at Hales Bar on the Tennessee River, 33 miles below Chattanooga, was formally started. The dam and lock were designed and constructed under the supervision of United States government engineers by the late Anthony N. Brady at a cost of approximately $9,000,000. The lock, which is situated on the west or right bank of the river, has the distinction of being the largest single lift in the world. It is built against a rock bluff, has a clear width of 60 ft., and is approximately 312 ft. long inside. The gates are of the mitering type, horizontally framed, built of steel and operated by electricity. These gates are somewhat remarkable for the head which they have to support, the difference in elevation between the two pools being about 40 ft. Each lift of the lower gates is 34 ft. long, 59 ft. high and weighs 129 tons. The lock chamber is filled by two culverts, 11 ft. by 6 ft., operated by stony sluice gates fitted for electrical operation. The dam itself is 1200 ft. long and extends from the lock on the west side of the river to the power house and transformer house on the east side. The crest of the dam is at an elevation of 635 ft. above the sea, and flashboards will bring the elevation of the crest 3 ft. higher. There is a passageway through the dam in which the electric conduits are carried from one side of the river to the other. The station is designed for 42,000 kw.

FIG. 1—HALES BAR STATION OF CHATTANOOGA & TENNESSEE RIVER POWER COMPANY

VARIATION IN FLOW OF RIVER

The total length of navigable waterways formed by the Tennessee and its tributaries is about 1300 miles. At Riverton, Ala., and Muscle Shoals, Ala., the obstructions to navigation have been removed by a system of canals and locks so that a 5-ft. depth of water is available the entire year from Paducah, Ky., where the Tennessee joins the Ohio, to Muscle Shoals, a distance of nearly 300 miles. Between Muscle Shoals and Chattanooga the low-water navigation was limited to a draft of water not exceeding 2 ft., and at high water the river was practically unnavigable. A 5-ft. depth of water will now be available for navigation all the way to Chattanooga.

The general characteristics of the Tennessee River are those of a broad, tranquil stream with moderate current. Where the river passes through the mountains below Chattanooga navigation presents great difficulties at low water on account of the rapids and rock barriers and also at high water because of the excessive velocities of flow. At Williams Island, 10 miles below Chattanooga, where the river enters the mountain section, difficult navigation commences. The width of the river at high water through this section does not exceed 1500 ft. and varies from 700 ft. at certain locations to the first figure. The low-water flow of the river at zero reading on the Chattanooga gage is about 8000 cu. ft. per second. At the high-water reading, 58 ft. on the Chattanooga gage, the flow is about 700,000 cu. ft. per second. From this it will be seen that the task of damming or improving the river was very difficult. In fact, there is practically no other river in the world in which the variation of flow is so large and the available channel so small. The maximum velocity encountered in going through the mountain section at maximum discharge is about 19 ft. per second, while the maximum velocity at low water is approximately 1.7 ft. per second.

In 1904 the business men of Chattanooga secured an act of Congress granting permission to the city of Chattanooga to build and construct a lock and dam across the Tennessee River at Scott's Point for improving navigation and for power purposes. The city, however, did not take up this franchise and a further clause of the act prompted private parties to accept what the city had failed to take. Mr. C. E. James and the late J. C. Guild, of Chattanooga, took up the franchise and together with the late A. N. Brady organized the Chattanooga & Tennessee River Power Company, which entered into contract with the United States government for the construction and maintenance of the works. It was found on investigation that the location of the dam at Scott's Point would not give sufficient improvement to the river nor sufficient water-power, owing to the backing up of tail-water at the higher stages of flow. Authorization was finally obtained for locating the dam at Hales Bar, 33 miles below Chattanooga, where rock was available for the dam foundation and where the flood plane

widened to such an extent that a rapid rise of the tail-water would not be so disastrous to a water-power development.

The head on the turbines at this place would be about 39 ft. at low water, while at a 40-ft. stage the backing up of the tail-water would reduce this head to about 19 ft. The lock and dam were designed under the direction of Major H. C. Newcomer. The designs for the water-power plant were made by Mr. John Bogart, consulting engineer

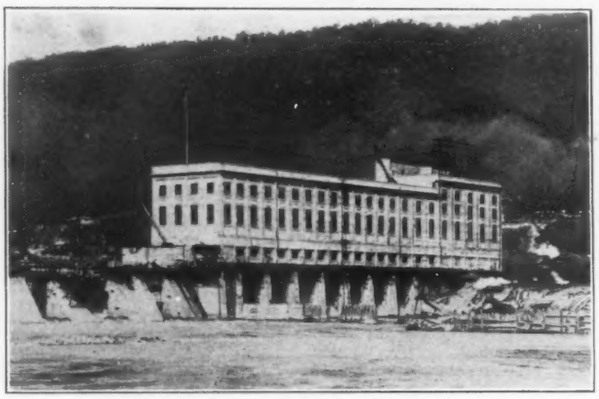


FIG. 2—VIEW OF STATION AT LOW WATER STAGE

of the Chattanooga & Tennessee River Power Company, while the mechanical and electrical designs were perfected by Mr. Thomas E. Murray, consulting engineer for Mr. Brady. The hydraulic problem was the most difficult of solution as the variation of flow is extremely large, ranging from 5000 cu. ft. per second as a minimum to 320,000 ft. per second at occasional floods. As a general statement it may be said that for two months of the year the flow varies between 8000 and 16,000 cu. ft. per second; for about four months between 12,000 and 60,000 cu. ft. per second; for about four months between 16,000 and 60,000 cu. ft. per second, and for about two months between 20,000 and

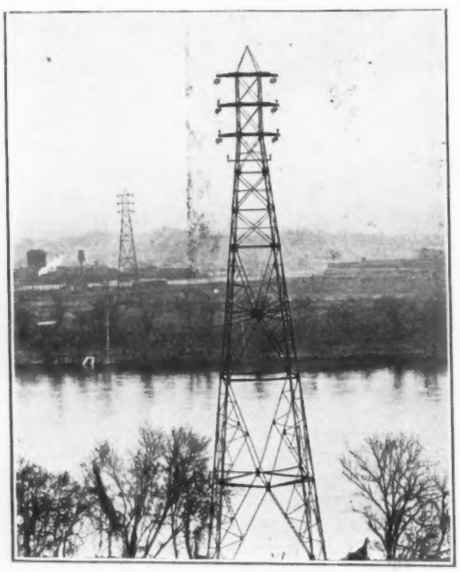


FIG. 3—TOWERS AT RIVER CROSSING

100,000 cu. ft. per second. During the shorter periods, of course, the maximum flow exceeds these figures.

Hydraulic Equipment

To secure uniformity of speed and regular output it was necessary to place three turbines on each shaft, the two lower ones operating during periods of high head and low flow, while the third turbine will be brought into play when there is more water but less available head. The lock and dam are built of concrete in which large stones up to 10 tons in weight have been embedded. Some reinforced concrete has also been used. The power house with its transformer house has been built of reinforced concrete. The latter is 66 ft. wide by 350 ft. long, comprising an operating building one story high and 220 ft. long and a switch and transformer house three stories high and 133 ft. long. The operating building consists of seven bays, each containing two turbine units, each unit consisting of three turbines mounted on a vertical shaft with a 3000-kw generator on its upper end. Under ordinary stages of the river only two of the turbines will be used for each unit. The two lower turbine wheels are 72 in. in diameter, and the upper wheel is 65 in. in diameter. The turbines run at 112.5 r.p.m., and each unit is capable of delivering 5250 hp under a head of 35 ft. The hydraulic machinery was built by the S. Morgan Smith Company, of York, Pa., and the governors by the Lombard Governor Company, of Ashland, Mass. An electric traveling crane of 50 tons rating is provided to handle the generators and turbines in the operating room and a

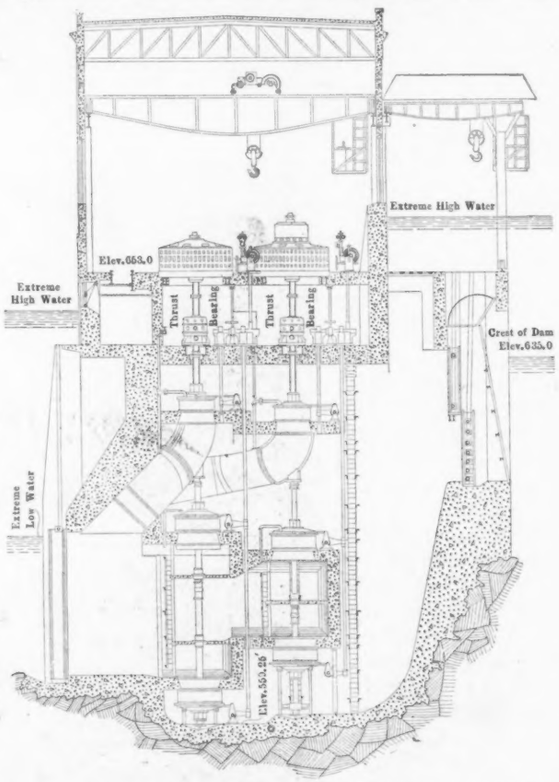


FIG. 4—CROSS-SECTION OF GENERATING STATION

gantry crane is placed on the upstream side of the operating building for handling the headgates.

Difficulties Encountered in Erecting Dam

Although the transmission line, substation and power house have been completed for some time, work on the dam has only just been finished. The engineers experienced no end of difficulty in obtaining a firm foundation for the dam. In the two bays at the east end of the power house no trouble whatever was experienced with water, but in the rest of the excavation large quantities came up through the natural crevices in the rock. At first an attempt was made to pump the water out during the process of the work, but the amount increased so fast that something had to be done to stop it. The water coming mainly from the bottom, well drills were secured for putting down holes 6 in. in diameter to any depth. A number of holes were put down in the bottom where foundations in the crevices and fissures would be met. The holes were as deep as 50 ft.

As the amount of water coming in increased and became too large to handle with pumps, the pit was allowed to flood with water to the level of the river. Pumps were then used to throw water into the pit so as to raise the level inside the cofferdam a little above that of the river. Before flooding, pipes were put into the well holes and carried up so as to be above the level of the water after flooding. These pipes were of the same size as the well holes and were bushed down on the top to 2 in. Cement grout was forced into the holes through the pipes by means of a small grouting machine and compressed air. Just enough pressure was used to force the grout out of the pipe and well into the hole. About 12,000 barrels of cement were used in the power-house foundation in this manner. After the foot of the power house had been excavated there was still trouble with the water coming up through the bottom whenever test holes were put down. In order to fill all openings and crevices in the rock immediately below the bottom of the power house, a large number of drill holes were made with the ordinary percussion drill. These holes, 2 in. in diamater, were filled with cement grout.

The dam on the east side of the river, covering about one-third of its length, was inclosed in a cofferdam divided into two sections by a cross cofferdam. The same trouble was met with here in connection with the bottom. At first well drills were used to stop the water by drilling and grouting as in the power house. Later, when the bottom was about secured, it was covered with small holes put down with ordinary percussion drills and then filled with grout. On the west side of the river about one-third of the width of the river was inclosed in one section of cofferdam. Before any material was excavated there well drills were put

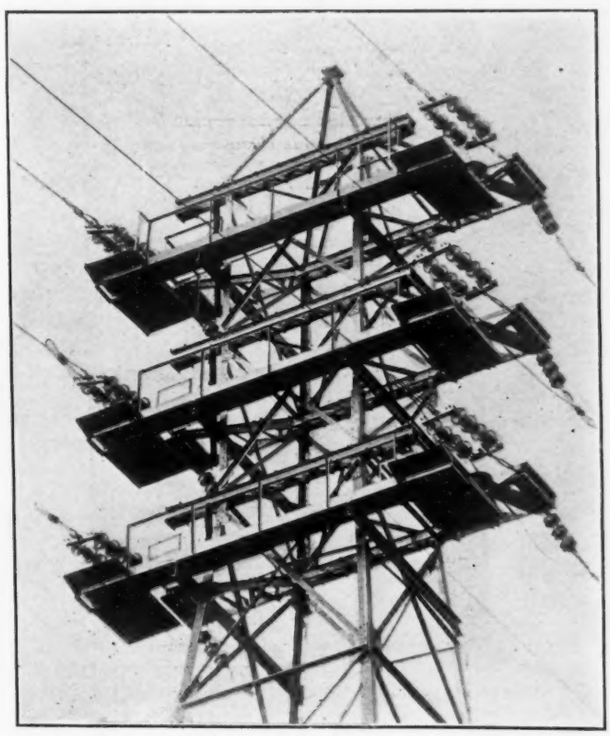


FIG. 5—WORKING PLATFORMS ON RIVER TOWER

at work over the entire bottom. A large proportion of the holes could not be driven as far as was desired owing to the fact that after the drill had passed the crevices sand and gravel would drop into the hole at the side of the drill. About 100 ft. of dam foundation was secured at the west side by the use of the holes for washing and filling the crevices as on the east side and in the power house. Then a new method was tried to get the bottom. The rest of the bottom inside the cofferdam was covered with fourteen caissons of different sizes, and these were sunk in the usual manner to good foundation rock. In building the dam gaps 20 ft. long were left so as to permit the water to pass through while the middle portion was cofferdammed.

GENERATING EQUIPMENT

The generating station is laid out to accommodate four-

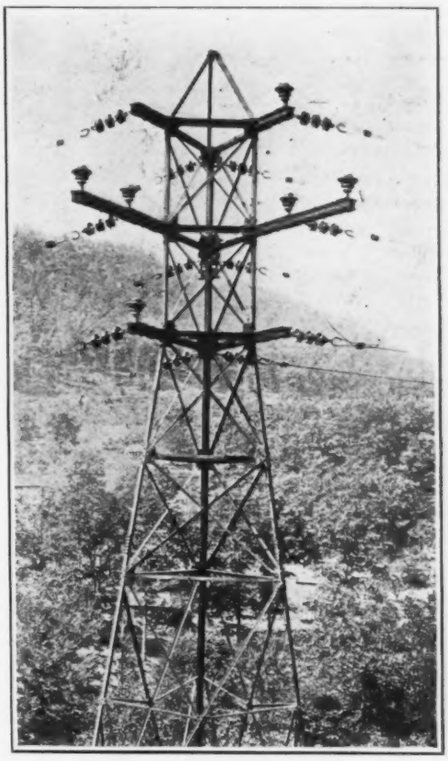


FIG. 6—STRAIN TOWER

teen three-phase, 60 cycle, 6600-volt generators, six exciters, one exciter switchboard, one alternating-current lamp and motor board, one alternating-current control board, fourteen alternating-current generator field rheostats, one storage battery, six step-down transformers, fifteen step-up transformers, twenty-nine 6600-volt motor-operated, oil circuit-breakers and buses, ten 45,000-volt, motor-operated, oil circuit-breakers and buses, three sets of multiplex lightning arresters and choke coils and three sets of electrolytic lightning arresters and horn-gaps. With the exception of the storage battery, all of the above apparatus was manufactured by the General Electric Company. The fourteen generators are located on the main floor of the operating room arranged in two rows, seven in each row. At present there are only ten installed, two of which have a 100-kw exciter mounted on the shaft.

On the main floor of the operating room near the switchboard are the other four exciters, each consisting of a 250-kw, 250-volt, 720 r.p.m. direct-current generator, driven by a 375-hp, 220-volt, 720-r.p.m., three-phase induction motor, both the generator and motor being mounted upon a common base and coupled together. On the same floor, close to the motor-driven exciters, are the exciter switchboard and the alternating-current lamp and motor board. At the extreme eastern end of the main floor of the operating room are six step-down, oil-cooled transformers each rated at 300 kw. three-phase, 60 cycles, 6600 to 230 volts. These transformers are located to the rear of the alternating-current lamp and motor board, but are separated therefrom by a fireproof inclosure. At present only five step-down transformers are installed, three of which furnish energy

to the exciter motors and two of which furnish energy for the lamps and motors throughout the station.

Above the exciter board and the step-down transformers is a gallery on which is located the main alternating-current 6600-volt and 44,000-volt control switchboard from which are also operated the alternating-current generator field rheostats. From each of the alternating-current gen-

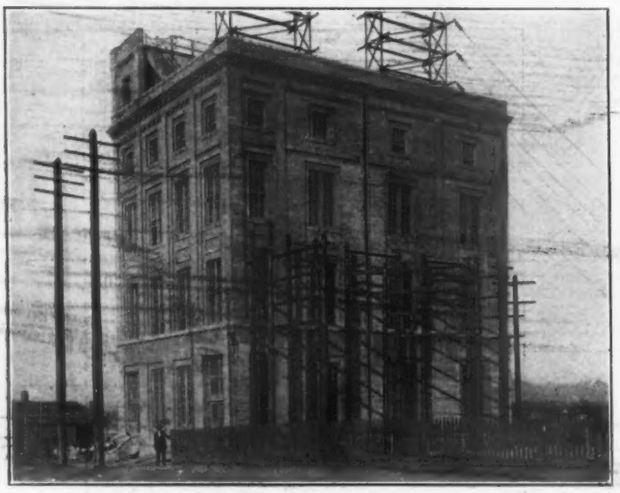


FIG. 7—SUBSTATION AT CHATTANOOGA

erators three single-conductor cables are run in bituminized fiber conduits laid in concrete to the generator oil circuit-breakers and generator buses, which are located in the north part of the first floor of the transformer house and divided from the operating house by a 12-in. concrete wall. From the generator buses the energy is sent through oil circuit-breakers to the step-up transformers located on the first floor, which are also separated from the switch room by a 12-in. concrete wall.

The step-up transformers will be grouped in five sets, three transformers to each set and each transformer having a rating of 3133 kw, wound for 25,400 volts and 44,000 volts on the high-tension side and 6600 volts on the low-tension side. These transformers are water-cooled, and at present only three of the fifteen are installed. The 44,000-volt energy from the step-up transformers is transmitted through oil circuit-breakers to the 44,000-volt buses, which are located partly on the second and partly on the third floor in the transformer house. On the latter floor are also the 44,000-volt and multiplex lightning arresters.

Transmission Line

The transmission lines leave the station at almost a right angle to the long side of the building and are carried to the substation in Chattanooga on 175 steel towers. The line follows for a great part of its route the tracks of the Nashville, Chattanooga & St. Louis Railroad Company, crossing them in six places, and in one instance crossing the tracks of the proposed route of the Southern Railroad Company quite close to the border of the State of Georgia. After going in an easterly direction about two-thirds of its total length, the line turns sharply north and continues in that direction until it reaches a point on the river near Moccasin Bend, where it turns northwest, crossing the Tennessee River at Moccasin Bend. Crossing the river for the second time, it enters the city of Chattanooga at the foot of Henry Street. From the foot of Henry Street the transmission line follows an easterly course parallel with Henry Street until it reaches the substation at the northwest corner of Henry and Carter Streets.

The two transmission lines are carried on single steel towers, each line consisting of three No. 000 bare copper cables, which are used in the whole distance of 17.5 miles, with the exception of the two crossings over the Tennessee River, where 350,000-circ. mil bare copper cable is used. On the top of the transmission towers, a steel grounding cable is clamped to the steel structures with cast-iron clamps and carried throughout the whole distance from the generating station to the substation. The steel towers vary in height, 35-ft., 40-ft., 45-ft. and 60-ft. towers being used for ordinary spans and 150-ft. and 170-ft. towers being used for the river crossings. All the towers are erected on concrete foundations, and owing to the mountainous character of the country the towers could not be erected at equal distances. The spans vary between 200 ft. and 700 ft., and over the Tennessee River they are 1400 ft. and 1500 ft. respectively.

Chattanooga Substation

The substation is a three-story and basement building, laid out to accommodate two sets of electrolytic lightning arresters and horn-gaps, two sets of multiple lightning arresters and choke coils, five 40,000-volt motor-operated oil circuit-breakers and buses, three 4000-volt motor-operated oil circuit-breakers and buses, one 40,000-volt control board, two 4000/2300-volt control boards, ten 2300-volt outgoing lighting feeders, fourteen 4000-volt outgoing motor feeders, one alternating-current station lamp and motor board, one motor-generator set, three 2300/115-volt oil-cooled step-down transformers for station lamps and motors, one storage battery, and nine 40,000/4000-volt main step-down transformers. The principal arrangement of the apparatus is similar to that in the generating station. At the present

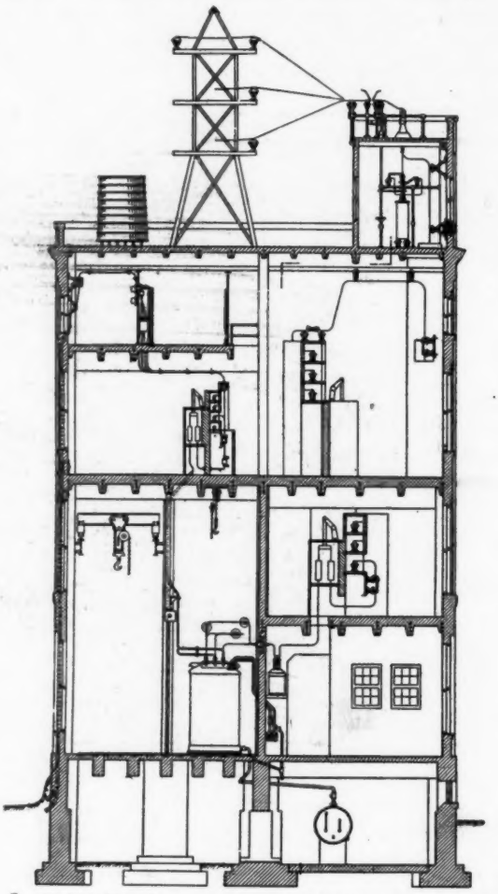


FIG. 8—CROSS-SECTION OF SUBSTATION AT CHATTANOOGA

time only two sets of transformers, two in a set, are installed. All outgoing 4000-volt and 2300-volt leads leave the building on a level with the third floor and are supported on wooden poles erected on the sidewalks. Provision is also made for carrying the outgoing feeders from the station in underground conduit. Mr. B. T. Burt is the resident engineer of the company at Chattanooga.

Industrial Lighting by Incandescent Lamps

Requirements of shop and factory illumination, methods of design and construction, and data on cost of operation of practical lighting systems. By Ward Harrison

THAT good illumination in industrial plants is a factor in the cost of production is generally appreciated. It is the purpose of this article to discuss the requirements which must be met in the design of a satisfactory lighting system, to point out methods of design to be followed, and to show cost figures which will

FIG. 1—LIGHTING OF A BINDERY

be of value to those contemplating the design of a practical lighting system.

There are four general requirements to be met—sufficient light of the proper quality on the work; a moderate intensity over the adjacent area and on the walls; absence of glare, and simplicity, reliability, ease of maintenance and low operating cost.

It is obvious that there must be sufficient light on the work. Better lighting facilities, along with practically all other improvements in industrial plants, are installed for the purpose of ultimately decreasing the unit cost of production. From an economic standpoint, however, it is very difficult, if not impossible, to determine the proper intensity for a given class of work. This intensity depends upon the cost of producing light, the number and wages of the employees and the value of their output, as well as upon the nature and fineness of the work and the possible reduction in spoilage. Owing to the difficulties encountered in evaluating these quantities, estimates of the intensity of illumination required for any class of work have usually been based on other than economic considerations.

Considered only from the standpoint of safety to employees, 0.25 ft.-candle may, in most instances, be taken as the lower limit of permissible intensity in an industrial plant. The upper limit of needful intensity may be conservatively estimated at from 50 to 100 ft.-candles. Illumination of this order is sometimes required for operations involving fine detail, rapidly moving machinery and black surfaces, such, for example, as are common in the shoe industry. In this connection it must be borne in mind that after the apparent brightness of an object has reached a certain magnitude a further increase of intensity does not appreciably aid vision. The necessary volume of incident light will, of course, depend upon the coefficient of reflection of the object illuminated, but even for fine work on very dark goods intensities of the order of those stated above are considered satisfactory. Such intense illumination is usually required over but a limited area and, therefore, can best be supplied by the use of small lamps and reflectors placed close to the work.

While from 0.25 to 100 ft.-candles may be considered as the extreme range of intensity for artificial lighting in factories, the great majority of installations will fall within much narrower limits, between approximately 1 ft.-candle and 6 ft.-candles. Many tables have been published designating the proper intensity of illumination for various classes of work, but this necessary intensity depends so largely upon the nature and distribution of the lighting units and upon local conditions as well as on the work to be performed that such tables should be used only with the greatest caution. Furthermore, as stated above, such estimates are at best based merely on what is now considered good practice in plants where illumination tests have been conducted. There is no definite assurance that either a higher or lower intensity of light would not tend toward a more economical operation of the plant. As a matter of fact, the cost of adequate illumination for an industrial plant is so low in comparison with the value of the output dependent upon it that in many cases intensities considerably higher than those now supplied will be found profitable. At present an expenditure of 1 watt per square foot of floor area using an overhead system of tungsten-filament lamps and enameled steel reflectors is

FIG. 2—LIGHTING OF A COMPOSING ROOM

considered good practice for machine shops and other locations with similar lighting requirements. This will on the average correspond to an initial intensity somewhat in excess of 5 ft.-candles. Tables which give values of illumination recommended for various locations should be understood as merely an approximate guide. One of the most useful of these is given in the 1912 report of the

industrial lighting committee of the National Electric Light Association.

To insure a satisfactory intensity of light on the work from a general overhead system of lighting, it is in most cases essential to provide light from several directions so that all sides of the objects viewed may be properly illuminated and so that if one lamp burns out, or the light from the unit be intercepted either by the operator's body or by parts of machinery, the resulting decrease in intensity will not be serious. In an installation of a few large units shadows are likely to be pronounced. Furthermore, there is a very decided decrease in the illumination when one lamp is extinguished and consequently the time of many workmen may be lost. A smaller unit will affect a smaller area and this area to a lesser degree.

Again, with the lighting system in which a considerable number of units are used over an area, it is less difficult to produce uniform illumination. Where one class of work is performed in a given area, a uniform intensity of light over this area will obviously result in the most economical use of the total quantity of light supplied. With any of the artificial illuminants now available, it is impracticable even to approach uniformity of illumination where the distance between units is greater than twice their height above the work. One and one-half times this height is a more satisfactory ratio. For a given mounting height the allowable spacing of units is constant and independent of their candle-power. From the reasons outlined above, it follows that an installation of a considerable number of units of low intensity will usually prove more satisfactory and, in the end, more economical than a system involving a small number of high candle-power illuminants.

A requirement of even greater importance than sufficient quantity of light of uniform intensity of illumination is that the intensity shall be constant. A flickering light produces the same effect rapidly repeated as is experienced when one passes from a dark room into bright sunshine. The efforts of the iris to accommodate the eye to the rapid changes of intensity produce muscular fatigue and nervous reaction which cause discomfort and pain.

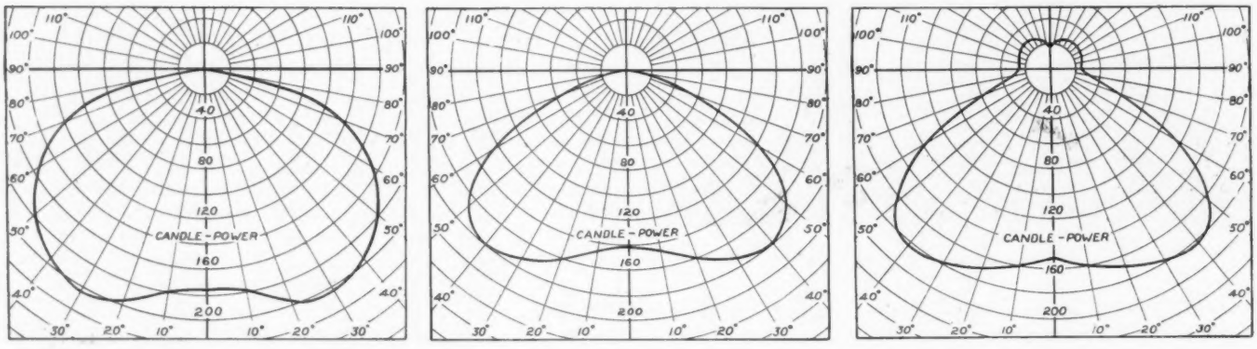
In addition to supplying the proper light on the work, a well-designed system of illumination should provide for some light on adjacent objects and on the shafting and belting, as well as on the walls and ceiling. In many shops the intensity, except at a few points, is so low that it is scarcely possible to see one's way about. Such lighting is not only inadequate from the standpoint of safety, but also strains the eye. If the work only is brilliantly lighted and the rest of the room is in comparative darkness, the uneven intensity encountered by the eye in shifting from the work has a tiring effect not unlike that of a flickering light source.

From the psychological standpoint, bright walls and ceiling lend an air of cheerfuness and wide-awakeness to a room which is wanting where the work only is illuminated. If, as in a cotton or a paper mill, the materials are of such a color that they will reflect a large proportion of the light incident upon them, the resulting illumination received on the walls and ceiling will be sufficient to obviate any appearance of gloom. If, on the other hand, the working surface is too dark to reflect much light in this manner, it may become advisable either to choose an illuminant which directs some of its light toward the ceiling and side walls, or else to provide a few lamps especially for this purpose. Such units would ordinarily be placed close to the ceiling in diffusing envelopes. If the walls and ceiling are necessarily dark, as in a foundry, it is, of course, useless to throw any light upon them. Keeping the walls and ceiling well whitewashed adds materially to the appearance of a shop as well as to the efficiency of the lighting installation.

Glare must be avoided. Glare is commonly defined as "light out of place." To cause glare, the disturbing element need not necessarily be a light unit. Glare may as well be the result of specular reflection from some brightly illuminated surface not far from the line of vision, or even from some polished portion of the work itself from which the image of the light source is reflected to the eye.

Recent investigations indicate that the extent to which vision is for the time impaired by glare depends primarily upon the total quantity of light received by the eye directly from the source, rather than upon intrinsic brilliancy; hence the distance between the eye and the source is of importance. If the source is of low intrinsic brilliancy—that is, if its candle-power per unit of area is low—the effect of glare usually disappears very soon after the cause is removed. If, however, the source is one of high intrinsic brilliancy, such as the filament of a tungsten lamp or the crater of an arc, it may not only decrease the ability to see during its presence within the field of vision but will also tire or permanently injure the eye. The seriousness of this latter effect depends largely on the distance between the eye and the light source and also upon the brightness of the background against which the source is viewed.

In order that a lighting system may not prove objection-



FIGS. 3, 4, 5—DISTRIBUTION CURVES, LAMPS WITH DOME ENAMELED-STEEL, BOWL ENAMELED-STEEL AND GLASS REFLECTORS

TABLE I—UTILIZATION EFFICIENCIES

Installation—Units Spaced 1.5 to 1.6 Times Height Above Work	Reflector	
	Enameled Steel Dome	Enameled Steel or Glass Bowl
One unit	28	24
One row of five units	42	36
Two rows of two units	48	41
Two rows of three units	52	44
Three rows of three units	56	47
Three rows of four units	60	49
Four rows of four units	63	51
Four rows of eight units	67	54
Eight rows of eight units	71	57

able from the standpoint of glare, it should be designed with a view to the following requirements: First—No source of light of high intrinsic brilliancy should be so located that it can readily be seen, except at a considerable distance. In cases where it is impossible to screen the source entirely, the presence of a brightly lighted background, such as the surface of a reflector, will considerably diminish the harmful effect. Second—No considerable amount of light even from a well-diffused source should be allowed to enter the pupil of the eye directly when it is focused on the work. This usually requires that no light source, unless remote, be visible when the head is inclined toward the working surface. Third—It is desirable that the area within the field of vision be uniformly illuminated; at least, the brightness of any portion of this area should not be materially greater than that of the object under observation. Fourth—Specular reflection should be guarded against so far as possible. Where the position of objects worked upon is fixed and the greater portion of the work is in one plane, lamps can be so placed as to avoid specular reflection in the direction of the eye. In the majority of operations in industrial plants, however, such conditions do not exist, and one should direct his efforts toward producing conditions which will allow the operator readily to shift his position in such a manner that direct reflection cannot reach his eye.

TABLE II—INTENSITY OF ILLUMINATION IN FOOT-CANDLES ON A HORIZONTAL PLANE PRODUCED BY A 1000-LUMEN SOURCE

Upper figures show intensity obtained with bowl enameled steel reflectors, lower figures, intensity with dome enameled steel reflectors

Height of Unit above Plane, Feet	Horizontal Distance from Unit, Feet																				
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
4	8.89 11.00	8.75 10.50	7.61 9.08	5.73 6.29	3.92 4.08	2.50 2.62	1.51 1.74	0.879 1.170	0.512 0.805	0.327 0.570	0.208 0.410	0.136 0.299	0.091 0.222	0.064 0.165	0.044 0.129	0.028 0.095	0.021 0.072	0.016 0.057	0.013 0.046	0.010 0.035	0.008 0.028
5	5.70 7.11	5.67 6.79	5.25 6.37	4.42 5.12	3.40 3.70	2.46 2.60	1.75 1.81	1.210 1.310	0.767 0.955	0.503 0.696	0.327 0.515	0.243 0.394	0.152 0.301	0.111 0.230	0.083 0.180	0.058 0.141	0.044 0.110	0.034 0.090	0.025 0.073	0.017 0.059	0.013 0.048
6	3.94 4.92	3.95 4.77	3.80 4.55	3.38 4.04	2.82 3.22	2.27 2.42	1.74 1.81	1.300 1.360	0.950 1.020	0.665 0.773	0.465 0.590	0.324 0.460	0.228 0.358	0.176 0.288	0.128 0.226	0.093 0.182	0.072 0.145	0.054 0.118	0.041 0.099	0.032 0.079	0.025 0.066
7	2.90 3.58	2.92 3.53	2.82 3.38	2.64 3.18	2.33 2.72	1.96 2.20	1.60 1.71	1.280 1.330	1.000 1.040	0.768 0.815	0.580 0.640	0.418 0.506	0.303 0.405	0.227 0.327	0.168 0.264	0.132 0.216	0.103 0.177	0.080 0.147	0.061 0.122	0.047 0.102	0.039 0.086
8	2.22 2.77	2.24 2.72	2.18 2.63	2.08 2.52	1.91 2.27	1.68 1.92	1.43 1.58	1.200 1.250	0.985 1.020	0.790 0.820	0.625 0.655	0.496 0.535	0.376 0.436	0.279 0.358	0.220 0.292	0.168 0.243	0.131 0.202	0.104 0.169	0.084 0.147	0.066 0.121	0.052 0.103
9	1.76 2.20	1.76 2.16	1.74 2.09	1.66 2.02	1.57 1.90	1.42 1.68	1.25 1.43	1.090 1.190	0.923 0.980	0.775 0.805	0.636 0.666	0.522 0.550	0.423 0.455	0.342 0.376	0.265 0.316	0.207 0.262	0.164 0.222	0.127 0.186	0.101 0.159	0.083 0.136	0.072 0.119
10	1.42 1.78	1.43 1.75	1.42 1.70	1.37 1.65	1.31 1.59	1.22 1.45	1.10 1.28	0.980 1.110	0.852 0.923	0.735 0.781	0.628 0.652	0.525 0.550	0.442 0.464	0.367 0.389	0.302 0.328	0.242 0.279	0.192 0.238	0.155 0.203	0.126 0.175	0.103 0.149	0.083 0.128
11	1.17 1.47	1.18 1.45	1.17 1.42	1.14 1.38	1.11 1.34	1.05 1.25	0.96 1.13	0.873 1.000	0.778 0.870	0.685 0.743	0.597 0.634	0.520 0.540	0.441 0.460	0.376 0.393	0.316 0.336	0.270 0.288	0.222 0.246	0.180 0.213	0.145 0.185	0.122 0.161	0.102 0.139
12	0.986 1.230	0.990 1.220	0.988 1.200	0.973 1.170	0.950 1.140	0.905 1.090	0.845 1.010	0.781 0.909	0.713 0.815	0.633 0.705	0.564 0.605	0.496 0.525	0.436 0.453	0.375 0.392	0.325 0.338	0.277 0.292	0.237 0.254	0.202 0.221	0.169 0.195	0.140 0.170	0.116 0.147
13	0.841 1.050	0.845 1.040	0.845 1.020	0.832 0.995	0.812 0.978	0.780 0.945	0.754 0.902	0.695 0.820	0.645 0.740	0.586 0.659	0.527 0.579	0.472 0.505	0.421 0.442	0.371 0.385	0.324 0.338	0.284 0.296	0.245 0.258	0.215 0.228	0.183 0.200	0.156 0.174	0.131 0.155
14	0.725 0.905	0.728 0.895	0.728 0.885	0.720 0.863	0.710 0.850	0.681 0.826	0.658 0.791	0.621 0.740	0.581 0.678	0.535 0.615	0.490 0.550	0.445 0.486	0.402 0.429	0.360 0.378	0.319 0.332	0.281 0.293	0.250 0.260	0.217 0.229	0.191 0.203	0.168 0.180	0.144 0.159
15	0.630 0.787	0.636 0.782	0.635 0.775	0.631 0.755	0.619 0.743	0.604 0.730	0.585 0.705	0.560 0.669	0.525 0.619	0.491 0.567	0.450 0.515	0.415 0.462	0.381 0.414	0.345 0.369	0.310 0.327	0.279 0.289	0.246 0.258	0.222 0.231	0.195 0.206	0.174 0.183	0.152 0.163
16	0.555 0.695	0.557 0.687	0.558 0.680	0.557 0.669	0.550 0.656	0.532 0.645	0.520 0.630	0.498 0.602	0.476 0.566	0.450 0.523	0.419 0.481	0.388 0.439	0.358 0.394	0.329 0.355	0.300 0.319	0.269 0.286	0.245 0.254	0.219 0.229	0.198 0.207	0.177 0.185	0.156 0.164
17	0.492 0.615	0.494 0.610	0.492 0.605	0.491 0.596	0.485 0.585	0.478 0.575	0.464 0.563	0.450 0.546	0.433 0.517	0.411 0.485	0.387 0.451	0.361 0.415	0.335 0.378	0.312 0.341	0.286 0.307	0.262 0.277	0.238 0.252	0.216 0.224	0.194 0.204	0.177 0.186	0.158 0.166
18	0.439 0.549	0.438 0.544	0.440 0.540	0.439 0.530	0.434 0.522	0.426 0.514	0.420 0.507	0.408 0.493	0.393 0.475	0.376 0.447	0.354 0.418	0.338 0.389	0.314 0.358	0.294 0.329	0.271 0.298	0.251 0.263	0.231 0.245	0.212 0.224	0.193 0.201	0.173 0.182	0.158 0.166
19	0.394 0.492	0.394 0.489	0.395 0.485	0.396 0.476	0.392 0.471	0.347 0.465	0.378 0.456	0.371 0.450	0.360 0.434	0.347 0.415	0.329 0.390	0.316 0.366	0.294 0.339	0.275 0.314	0.256 0.288	0.238 0.262	0.223 0.238	0.206 0.219	0.188 0.199	0.174 0.180	0.157 0.165
20	0.355 0.445	0.356 0.440	0.354 0.436	0.358 0.433	0.356 0.425	0.349 0.420	0.342 0.412	0.336 0.408	0.328 0.397	0.320 0.382	0.304 0.363	0.289 0.341	0.277 0.320	0.259 0.297	0.243 0.274	0.228 0.252	0.214 0.231	0.199 0.213	0.185 0.196	0.169 0.178	0.156 0.162

ILLUMINATION CALCULATIONS

The recommendation has been made that for purposes of general illumination in factories lamps be spaced at intervals approximately 50 per cent greater than their height above the plane illuminated. This spacing of units will result in a sufficiently uniform illumination in all cases except where a markedly concentrating reflector is used. If this rule for spacing is followed, it is not difficult to estimate the average intensity of light over the working area. In an installation comprising three or more rows of units the estimate may be made with considerable accuracy. In such an installation using a tungsten-filament lamp and the best grade of dome reflector having a distribution similar to that shown in Fig. 3 a light flux approximating 60 to 70 per cent of the total quantity emitted by this bare lamp will reach the working plane. For example, a 100-watt lamp will produce initially 908 lumens and about 575 of these will be effective. If the lamps are spaced on 10-ft. centers, the 575 lumens will be spread over 100 sq. ft. and the resulting intensity will be 5.75 ft.-candles. This, of course, is a value for the initial intensity of light and, therefore, estimates relating thereto should be reduced by an amount sufficient to allow for the falling off in efficiency of the lamps and the accumulation of dust (see Figs. 6 and 7). If, in place of the dome reflectors, bowl enameled-steel or dense opal glass reflectors are used (Figs. 4 and 5), about 50 per cent of the total light, or 475 lumens, will be effective and the average intensity over the area of 100 sq. ft. will be 4.75 ft.-candles.

The foregoing data apply to a relatively large area free from obstructions, but no allowance has been made for light reflected from walls and ceiling. In a large room the increase in intensity resulting from such reflection will in most cases be negligible when steel reflectors are used. If the space to be illuminated is narrow in comparison with the desirable mounting height of units, so that not more than one or two rows of lamps can be installed, the efficiency of the system will be considerably less and will be dependent to a greater extent upon reflection from the walls. An extreme case of this nature is represented by an area 10 ft. square illuminated by a single unit placed about 6.5 ft. above the working plane, or approximately 9 ft. above the floor. Obviously, in this case, the illumination will not be uniform, and, unless the walls are light, the efficiency of the system will be less than one-half that obtained in a large installation. This low efficiency is due solely to the fact that a very large percentage of the light rays emitted by the unit must of necessity strike the inclosing walls before they can reach the working plane. If these walls are white, the percentage of light on the working plane may be increased from 30 to 60 per cent, depending upon the reflector employed. Table I gives values for the efficiency of utilization of a number of typical installations. Knowing the efficiency of utilization of a lighting system, one may obtain the average intensity of illumination as follows:

Let L = Total lumens per lamp.
K = Utilization efficiency.
A = Average number of square feet illuminated by each lamp.
I = Average intensity in foot-candles.
Then $I = L K \div A$.

It is in most cases sufficiently accurate from a practical standpoint if the intensity of illumination is predetermined within from 5 to 10 per cent; hence, in making calculations, certain approximations as outlined above are permissible.

Another but rather laborious method of calculating illumination, in which the distribution curve of the unit is used, is known as the point-by-point method, tables of constants for which have been published from time to time. To determine the illumination in foot-candles of any point on a horizontal plane a given distance below the unit, the candle-power (taken from the distribution curve of the unit used) at the proper angle is multiplied by a corresponding constant. In practice, the accuracy with this method is but little greater than with the one previously considered, since individual curves of light distribution on lamps and reflectors of the same designation will be found to vary somewhat and curves on units of different sizes of the same type and manufacture are not exactly similar in shape or equal in efficiency.

The candle-power curve for a bowl enameled-steel reflector given in Fig. 4 represents the mean of tests on units

TABLE III—DISTRIBUTION OF LIGHT FLUX

Zone, Degs.	Enameled Steel Dome		Enameled Steel Bowl		Dense Opal Bowl	
	Lumens in Zone	Summation of Lumens from 0 Deg. Nadir	Lumens in Zone	Summation of Lumens from 0 Deg. Nadir	Lumens in Zone	Summation of Lumens from 0 Deg. Nadir
0- 10	17	17	14	14	15	15
10- 20	53	70	43	57	46	61
20- 30	94	164	78	135	80	141
30- 40	127	291	112	247	114	255
40- 50	143	434	138	385	138	393
50- 60	150	584	136	521	128	521
60- 70	141	725	86	607	84	605
70- 80	89	814	29	636	46	651
80- 90	6	820	3	639	29	680
90-180	0	820	0	639	164	844

of all sizes ranging from 40 watts to 250 watts. The average deviation of the individual curves from the mean value at various angles is 5 per cent and the average deviation in hemispherical flux values is only 2 per cent. The numerical values apply for clear tungsten-filament lamps operated in such a way as to produce a total of 1000 lumens. This corresponds to a 100-watt unit operated at 10 lumens per watt, or, very closely, 1 watt per horizontal candle-power. Curves for dome enameled-steel and dense opal glass reflectors are given in Figs. 3 and 5. Plotting curves on this basis greatly facilitates the comparison of units in which the lamps are of different sizes and efficiencies. Illumination values may also be calculated most conveniently by

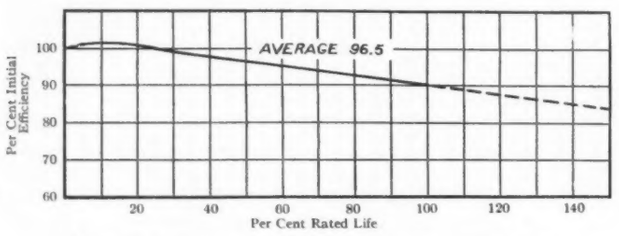


FIG. 6—VARIATION OF EFFICIENCY WITH LIFE

using such curves and correcting the final results by the ratio of the total lumens of the lamp chosen to 1000 lumens.

In Table II are given foot-candle values which have been calculated for various points under the units for which distribution curves are shown in Figs. 3 and 4. A single example will serve to illustrate the use of this table. It is required to determine the intensity of illumination at a point on a horizontal plane illuminated by three 60-watt tungsten-filament lamps equipped with dome reflectors when the units are suspended 7 ft. above the plane and their horizontal distances from the point are 2 ft., 7 ft. and 13 ft. respectively. From Table II it is found that at a point 7 ft. below the unit and 2 ft. out the horizontal illumination produced by the dome-shaped unit, the curve for

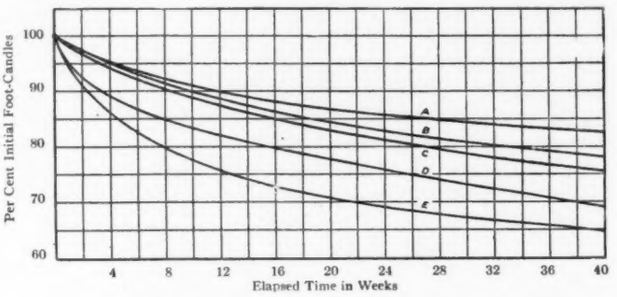


FIG. 7—VARIATION OF CANDLE-POWER WITH LIFE

which is given in Fig. 3, is 2.89 ft.-candles. The illumination for the other distances may be determined in a similar manner. The total becomes:

$$2.89 + 0.86 + 0.02 = 3.77 \text{ ft.-candles.}$$

This is the illumination produced by three units generating 1000 lumens each; hence, when using 60-watt units generating 526 lumens each, the intensity at the point designated will be:

$$0.526 \times 3.77 = 1.98 \text{ ft.-candles.}$$

While the usual distribution curve shows the average intensity of the light source in various zones, it does not indicate directly the distribution of the total volume of light. In order to obtain a better idea of the quantity or flux of light in the various zones, the values computed for the curves shown in Figs. 3, 4 and 5 are given in Table III. In the first column are values for lumens emitted within the successive 10-deg. zones beginning at a point directly

TABLE IV—ANALYSIS OF OPERATING COSTS—100-VOLT TO 130-VOLT TUNGSTEN UNITS

	Size of Lamp, Rated Watts						
	40	60	100	150	250	400	500
Cost of lamp, list	$0.350	$0.450	$0.800	$1.200	$2.000	$3.600	$4.000
Cost of lamp, standard-package discount	0.315	0.405	0.720	1.080	1.800	3.240	3.600
Cost of reflector, standard-package discount	1.155	1.292	1.566	1.653	1.653	2.617	2.617
Cost of unit, standard-package discount	1.470	1.697	2.286	2.733	3.453	5.857	6.217
Annual Fixed Charges:							
Interest on total investment, 6 per cent	$0.088	$0.102	$0.137	$0.164	$0.207	$0.351	$0.373
Depreciation on reflector, 12 1-2 per cent	0.144	0.162	0.196	0.207	0.207	0.327	0.327
Labor, monthly cleaning	0.240	0.240	0.240	0.360	0.360	0.480	0.480
Total	$0.472	$0.504	$0.573	$0.731	$0.774	$1.158	$1.180
Maintenance Cost per 1000 Hours:							
Lamp renewals at standard-package discount	$0.315	$0.405	$0.720	$1.080	$1.800	$3.240	$3.600
Lamp renewals at $150-contract discount	0.291	0.374	0.664	0.996	1.660	2.988	3.320
Lamp renewals at $1200-contract discount	0.256	0.329	0.584	0.876	1.460	2.628	2.920
Energy cost per 1000 hours at 1 cent per kw-hr	$0.400	$0.600	$1.000	$1.500	$2.500	$4.000	$5.000

below the lamp. In the second column is the summation of the lumens from 0 deg. (nadir) to the upper limit of each zone. The light within a certain zone is sometimes considered as "useful" when this quantity is available for the direct lighting of the working plane. The actual percentage of total light that can be directly utilized, and consequently the efficiency, depends upon the area lighted

and the number of rows of units. There is therefore a very direct connection between the figures given in Table I and those of Table III. The larger the number of rows, the greater the angle within which the light emitted from the unit may be efficiently utilized. In very large areas practically all of the flux within 70 deg. of the axis of the lamp can be used without the losses attending reflection from walls.

Since the intensity of illumination at any point on a plane varies inversely as the square of its distance from the light source, it is sometimes assumed that in a large building, such as a foundry, the efficiency of the lighting system is necessarily impaired when the lamps are hung high in order to clear the cranes. It should be borne in mind, however, that the height of the lamps in feet has itself no influence upon the efficiency of utilization, which depends solely on the number of units installed and the ratio of their height and spacing. For example, if there are two buildings, one 20 ft. by 50 ft. and 10 ft. in height and the other 40 ft. by 100 ft. and 20 ft. in height, it is clear from Fig. 8 that the effective angle, and hence the efficiencies of the lighting systems in the two buildings, will be the same. If the small building is illuminated by eight 100-watt lamps on 10-ft. centers and the large building by the same number of 400-watt lamps on 20-ft. centers, the average intensity of illumination will be the same, neglecting the difference in the efficiencies of the units, and its distribution will be similar.

TABLE V—TOTAL ANNUAL OPERATING COSTS—100-VOLT TO 130-VOLT TUNGSTEN UNITS

		Size of Lamp, Rated Watts						
	Energy Cost, Cents	40	60	100	150	250	400	500
1000 hours' operation per year. Lamps bought on $150 contract	1	$1.16	$1.48	$2.24	$3.23	$4.93	$8.15	$9.50
	2	1.56	2.08	3.24	4.73	7.43	12.15	14.50
	3	1.96	2.68	4.24	6.23	9.93	16.15	19.50
	4	2.36	3.28	5.24	7.73	12.43	20.15	24.50
	5	2.76	3.88	6.24	9.23	14.93	24.15	29.50
	6	3.16	4.48	7.24	10.73	17.43	28.15	34.50
	8	3.96	5.68	9.24	13.73	22.43	36.15	44.50
	10	4.76	6.88	11.24	16.73	27.43	44.15	54.50
1000 hours' operation per year. Lamps bought on $1,200 contract	1	1.13	1.43	2.16	3.11	4.73	7.79	9.10
	2	1.53	2.03	3.16	4.61	7.23	11.79	14.10
	3	1.93	2.63	4.16	6.11	9.73	15.79	19.10
	4	2.33	3.23	5.16	7.61	12.23	19.79	24.10
	5	2.73	3.83	6.16	9.11	14.73	23.79	29.10
	6	3.13	4.43	7.16	10.61	17.23	27.79	34.10
	8	3.93	5.63	9.16	13.61	22.23	35.79	44.10
	10	4.73	6.83	11.16	16.61	27.23	43.79	54.10
4000 hours' operation per year. Lamps bought on $150 contract	1	3.24	4.40	7.23	10.72	17.41	29.11	34.46
	1 1–2	4.04	5.60	9.23	13.72	22.41	37.11	44.46
	2	4.84	6.80	11.23	16.72	27.41	45.11	54.46
	3	6.44	9.20	15.23	22.72	37.41	61.11	74.46
	4	8.04	11.60	19.23	28.72	47.41	77.11	94.46
4000 hours' operation per year. Lamps bought on $1,200 contract	1	3.10	4.22	6.91	10.24	16.61	27.67	32.86
	1 1–2	3.90	5.42	8.91	13.24	21.61	35.67	42.86
	2	4.70	6.62	10.91	16.24	26.61	43.67	52.86
	3	6.30	9.02	14.91	22.24	36.61	59.67	72.86
	4	7.90	11.42	18.91	28.24	46.61	75.67	92.86

Cost Calculations

In determining the total operating cost of any system of lighting, three items must be considered:

First—Fixed charges, which include interest on the investment, depreciation of permanent parts and other expenses which are independent of the number of hours of use. Frequently this item forms the greater part of the total operating expense, yet it is only too often omitted from cost tables.

Second—Maintenance charges, which include renewal of parts, repairs, labor and all costs, except the cost of energy, which depend upon the hours of burning.

Third—The cost of energy, which depends upon the hours of burning and the rate per kilowatt-hour.

The life of a lighting system depends not only upon the wearing out of parts, but also upon obsolescence. There are no installations in this country which have been in use for a period of seven or eight years which are not already obsolete. Although the lamps may be in good operating condition, economy demands that they be replaced by more efficient illuminants. There is every indication that the next few years will see even greater progress in the development of lamps and the use of light. The rate of depreciation on all permanent parts is equal to at least 12.5 per cent. The investment required in the tungsten system of lighting is relatively very low.

A table which would show the total operating expense of tungsten lamps for all sizes, with every discount from the list prices, for all possible periods of burning per year, and under all cost of energy, would be so large as to be entirely impracticable. From Table V, however, the operating expense of units under any set of conditions may be found with little calculation.

The total investment includes the cost of lamps, reflectors, holders and sockets. The investment in permanent parts is the total investment minus the price of lamps. No depreciation is charged against the lamps inasmuch as they are regularly renewed. The labor item under fixed charges provides for the cleaning of all units once each month. For the smaller units with steel reflectors the cost of cleaning is taken as $0.02 per unit for each cleaning. Data obtained from installations where accurate cost records are kept show that this figure is conservative for labor at $0.20 per hour. The cost of cleaning other reflectors is taken in proportion to the amount of labor required. Some illuminants require attendance at regular intervals. The cleaning is done at the same time and is, therefore, included under the maintenance charge. For units which require no regular attendance the cleaning expense becomes a separate charge. It will be noted that the fixed charges form only a small part of the total operating cost for a lighting system.

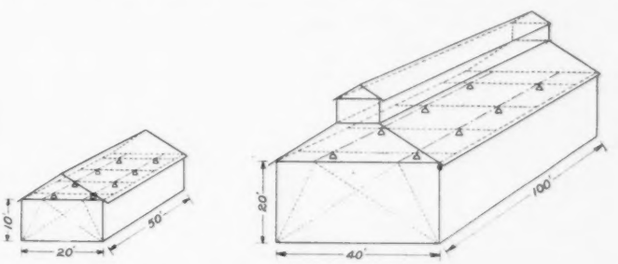


FIG. 8—BUILDINGS WITH IDENTICAL LIGHTING EFFICIENCIES

The maintenance charge is given for a 1000-hour period of burning. To find the annual charge in any case, it is necessary to multiply by the ratio of the total hours of burning to 1000 hours. Where lamps are sold at other than the prices given, the proper correction should be applied. The renewal of lamps is the only maintenance expense.

The energy cost is given for a 1000-hour period with energy at $0.01 per kilowatt-hour.

An example will illustrate the use of Table IV. It is required to find the total operating expense per unit per year for lighting a mill with 250-watt tungsten-filament lamps. The lamps are burned a total of 4000 hours and are purchased at the discount obtained on a $150 contract. The cost of energy is $0.20 per kilowatt-hour.

From the table we obtain the following:

(1) Fixed charges	$0.774
(2) Maintenance, 4.000 × $1.800	7.200
(3) Energy, 4.000 × 2 × $2.50	20.000
Total	$27.974

In Table V are included annual operating costs which have been calculated for a number of cases frequently met in industrial plants.

Effective Resistance and Reactance

Graphic and algebraic treatment of the relations in alternating-current circuits surrounded by magnetic conducting material. By Waldo V. Lyon

THE object of this paper is to give a simple discussion of an electric circuit with which is associated magnetic or non-magnetic conducting material in which energy is dissipated owing to hysteresis, to eddy currents or to both. In order to keep the discussion within the bounds of simplicity it will be necessary to make various assumptions. At the proper places these assumptions will be stated so that the limitations of the conclusions may not be lost sight of. It is assumed initially that the current and voltages are simple harmonic functions of the time, and whenever this is contrary to fact the actual voltage and current are replaced by their equivalent harmonic values. The apparent resistance of an electric conductor to alternating current is greater than it is to direct current, owing to the fact that the varying magnetic field set up by the current causes a non-uniform distribution of the current over the cross-section of the conductor. But for conductors not larger than No. 0 and for frequencies not greater than 60 cycles the apparent resistance to alternating current is practically the same as the ordinary ohmic resistance.

When considering a simple impedance circuit, as, for example, a so-called reactor, or a transformer on open circuit, it is customary to regard the circuit as consisting of a resistance R in series with a reactance X. The relations that fix the values of this resistance and reactance are expressed in the following equations:

$$\sqrt{R^2+X^2}=\frac{E}{I} \qquad (1)$$

$$R=\frac{P}{I^2} \qquad (2)$$

E, I and P are respectively the impressed voltage, the current and the power supplied to the circuit. These relations do not in any way depend upon the magnitude, the form-factor or the frequency of the impressed voltage. It is only necessary that E and I should be the effective values of the voltage and current and P the average watts supplied. Assuming that the actual voltage and current are replaced by their equivalent harmonic values, they can be represented by vectors as in Fig. 1. E is the fall in potention through the circuit and I is the current in the direction in which the fall is taken. RI and jXI are called the effective resistance and the effective reactance drops. Cos θ is the power factor.

It is often assumed that R is constant and X proportional to the inductance of the circuit and the frequency of the impressed voltage. In practice this is not generally so, for whenever the power supplied to the circuit includes hysteresis or eddy-current losses, the resistance R may vary over a considerable range and the reactance X is not proportional to the inductance and frequency alone. Even though there be no hysteresis or eddy-current losses, the reactance can be expressed by the simple formula $X=2\pi fL$ only when the current is a simple harmonic function of the time. Whenever the current is a periodic non-sinusoidal function the equations for the effective resistance and the effective reactance become very complicated. In this case the expressions for the voltage, current and power are those which are embraced in the following forms:

$$E^2=E_1^2+E_2^2+E_3^2+\ \ldots$$

$$I^2=\frac{E_1^2}{R_1^2+X_1^2}+\frac{E_2^2}{R_2^2+X_2^2}+\frac{E_3^2}{R_3^2+X_3^2}+\ \ldots$$

$$P=\frac{E_1^2R_1}{R_1^2+X_1^2}+\frac{E_2^2R_2}{R_2^2+X_2^2}+\frac{E_3^2R_3}{R_3^2+X_3^2}+\ \ldots$$

E_1, E_2 and E_3 are the effective values of the fundamental and harmonic components of the impressed voltage. R_1, R_2 and R_3 are the effective resistances of the circuit at the respective frequencies of the fundamental and the successive harmonics. They are not equal. X_1, X_2 and X_3 are the effective reactances of the circuit at the respective frequencies of the fundamental and the successive harmonics. They are not proportional to the frequencies. These equations show the necessity for assuming that the voltage and current are simple harmonic functions.

The first and simplest case to consider is that of a coil of conducting material with which is associated no magnetic or other conducting material. In this case the mag-

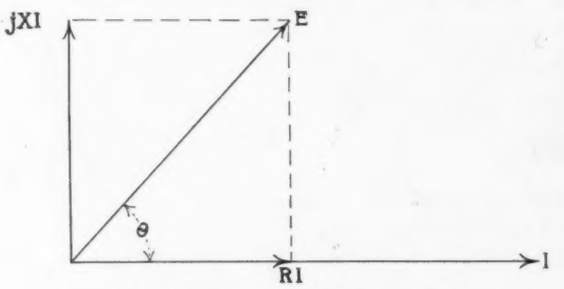


FIG. 1—SIMPLE VECTOR RELATIONS

netic flux is directly proportional to the current and there are no losses but the joule heating in the conductor itself. The magnetic flux and the current will be in time-phase and the generated voltage in the coil—namely, the reactance voltage—will be in time-quadrature with the flux and hence with the current. The vector diagram is given in Fig. 2. In this case only do the true resistances and reactance satisfy the equations (1) and (2). Thus:

$$\sqrt{r^2+x^2}=\frac{E}{I}$$

$$r=\frac{P}{I^2}$$

The ohmic and reactance drops are in time-quadrature. The actual generated voltage lags behind the flux by 90 deg., and the component of the impressed voltage E necessary to balance this is the true reactance drop (jIx).

The second case to be considered is one in which the electric circuit has associated with it non-magnetic conducting material in which eddy currents are produced. We will assume that the electromotive force which produces the eddy currents is in time-quadrature with the flux produced by the current in the electric circuit, and that this electro-

motive force and the eddy currents are in time-phase. The vector digram is given in Fig. 3

The flux φ produced by the magnetizing current I_f generates in the electric circuit a voltage which is numerically equal to the true reactive drop jI_fx. This flux also generates in the associated conducting material an electromotive force which is in time-quadrature with it and which

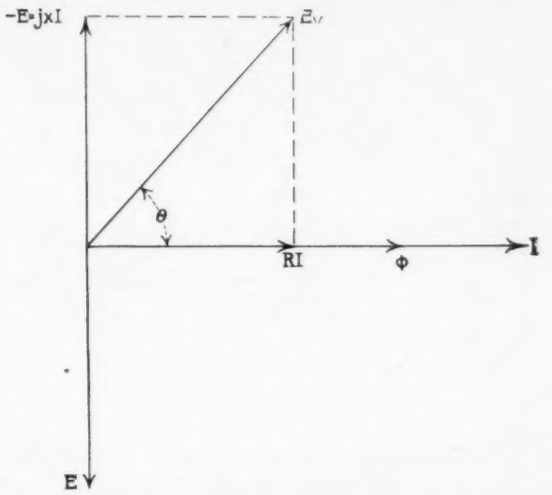


FIG. 2—VECTOR RELATIONS IN CIRCUIT WITHOUT MAGNETIC MATERIAL

produces the eddy currents. The eddy currents, which are represented by the vector I_e', produce a demagnetizing effect on the magnetic circuit, to neutralize which a component current I_e must be supplied to the electric circuit. The actual current I existing in the electric circuit is the sum of these two components I_f and I_e. The ohmic drop is in time-phase with this current. The impressed voltage is the sum of its two components, jI_fx and Ir, and is shown in the diagram by the vector E. The reactive and resistance drops are no longer in time quadrature.

The third case to be considered is that of an electric circuit with which is associated non-conducting magnetic material. Such a material is not known, but the theoretical consideration of this case serves to separate the effects of eddy currents and hysteresis. In this case if the voltage generated in the electric circuit is a simple harmonic function of the time, the current will be distorted and will contain higher harmonics. There will also be energy dissipated in what is called hysteresis. As we are to assume simple harmonic functions, this actual current must be replaced by its equivalent sine value. The generated voltage and the current may then be represented by vectors, and the current will lead this voltage by an angle greater than 90 deg., since energy is dissipated. The vector diagram is given in Fig. 4.

The component I_f of the equivalent sine current I, which is in time-phase with the flux φ, is the magnetizing component. The other component of the current, I_h, which is in time-quadrature with the magnetizing current I_f and in time-opposition to the generated voltage E is the hysteresis component of the current. The angle η by which the current I leads the flux φ is the angle of hysteretic advance.

The final case to consider is that of an electric circuit with which is associated magnetic and conducting material. The vector diagram is given in Fig. 5 and is a combination of those which represent the second and third cases.

The current I is divided into two components which are in time-quadrature—the magnetizing component I_f, which is in time-phase with the flux φ, and the core loss component I_e, which is in time-quadrature with the flux. The impressed voltage is divided into two components which are not in time-quadrature. The resistance drop is in time-phase with the actual current I, while the true reactive drop is in time-quadrature with the flux and hence with the magnetizing component of the current I_f.

As previously stated, it is customary to divide the impressed voltage into two components which are in time-quadrature. The first of these is the effective resistance drop and is in time-phase with the actual current. The second is the effective reactance drop and is in time-quadrature with the current. In Fig. 5 these are respectively IR and IX. We can now find the relations that exist between the effective resistance and reactance and the actual resistance and reactance. It will be seen from Fig. 5 that:

$$IR = Ir + I_f x \sin \alpha$$

but

$$I_f = I \cos \alpha$$

$$\therefore R = r + x \sin \alpha \cos \alpha \qquad (3)$$

Likewise

$$IX = I_f x \cos \alpha$$

and

$$X = x \cos^2 \alpha \qquad (4)$$

When the error would be slight we will assume that the resistance r of the circuit is the same as it would be to direct current. If necessary, its actual value can be closely calculated by making suitable approximations. Equations (3) and (4) show that whenever there are core losses the effective resistance is always greater than the actual resistance and the effective reactance is always less than the actual reactance.

The solution of equations (3) and (4) for the actual reactance and the angle α will give:

$$x = X + \frac{(R-r)^2}{X} \qquad (5)$$

$$\tan \alpha = \frac{R-r}{X}$$

The values of R and X are determined by equations (1) and (2) and r can be measured with direct current. If equation (5) is solved for the value of the effective reactance in terms of the effective resistance, the ohmic resistance and the actual reactance, we have

$$X = \frac{x + \sqrt{x^2 - 4(R-r)^2}}{2}$$

This shows that the greatest value that $(R-r)$ can have is $\frac{x}{2}$, otherwise the value of X would be imaginary. But

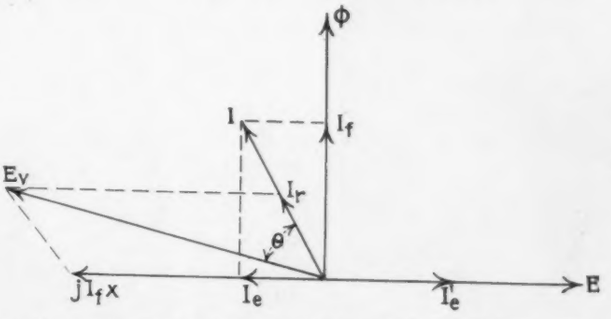


FIG. 3—VECTOR RELATIONS WHEN EDDY CURRENTS ARE PRESENT

$$(R-r) = x \sin \alpha \cos \alpha$$

Therefore the effective resistance R has its greatest possible value when

$$\sin \alpha \cos \alpha = \frac{1}{2}$$

that is, when $\alpha = 45$ deg.

The value of the magnetizing component of the current, which it is often necessary to know, is found by substituting the value of cos α in the equation:

$$I_f = I\cos\alpha$$

$$I_f = \frac{X}{\sqrt{X^2 + (R-r)^2}}\,I \qquad (6)$$

It will now be shown how the effective resistance and the effective reactance vary with the impressed voltage and the frequency. In order to simplify the expressions as much as possible it will be necessary to assume that the actual reactance is proportional to the frequency alone, i.e., $x = fx_1$. This would not be so on account of saturation. The magnetizing current is equal to the generated electromotive force divided by the actual reactance.

$$I_f = \frac{E}{fx_1}$$

The core loss is given by the expression:

$$P_c = EI_c = K_1E^2 + K_2E\left(\frac{E}{f}\right)^{\eta-1}$$

η is the Steinmetz exponent. From this:

$$I_c = K_1E + K_2\left(\frac{E}{f}\right)^{\eta-1}$$

$$\sin\alpha = \frac{I_c}{\sqrt{I_f^2 + I_c^2}}$$

$$\cos\alpha = \frac{I_f}{\sqrt{I_f^2 + I_c^2}}$$

Equations (3) and (4) may now be written in the following terms:

$$R - r = \frac{E\left(K_1E + K_2\left(\frac{E}{f}\right)^{\eta-1}\right)}{\left(\frac{E}{fx_1}\right)^2 + \left[K_1E + K_2\left(\frac{E}{f}\right)^{\eta-1}\right]^2}$$

$$X = \frac{fx_1\left(\frac{E}{fx_1}\right)^2}{\left(\frac{E}{fx_1}\right)^2 + \left[K_1E + K_2\left(\frac{E}{f}\right)^{\eta-1}\right]^2}$$

K_1 and K_2 are constants determined by the division of the total core loss between eddy-current and hysteresis loss. E is the generated voltage due to self-induction.

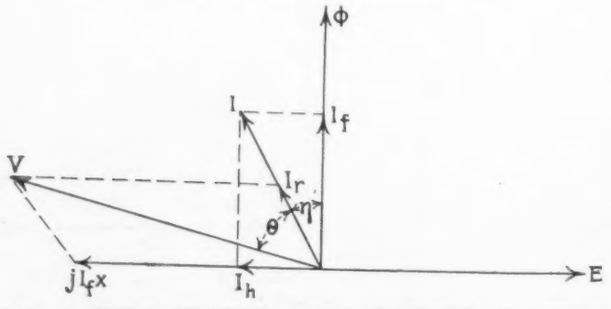


FIG. 4—VECTOR RELATIONS WHEN HYSTERESIS IS PRESENT

In general, both the effective resistance and the effective reactance depend upon the impressed voltage and the frequency. When there is no hysteresis loss, as with an insulated coil wound on a copper tube, the effective resistance and reactance are both independent of the impressed voltage, but the effective reactance does not vary directly with the frequency. If the eddy current loss should be so small as to be negligible and the generated voltage and frequency are kept in the same ratio—that is, the flux density is constant—the hysteresis resistance $R - r$ would vary directly with E and the effective reactance X would be directly proportional to the frequency, but not equal to $2\pi fL$.

We are often interested in determining the flux that will

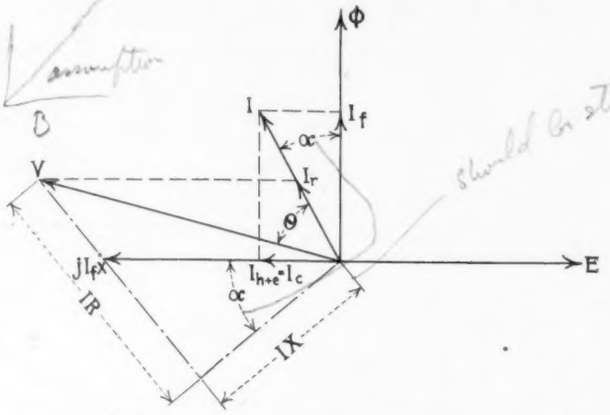


FIG. 5—VECTOR RELATIONS WHEN HYSTERESIS AND EDDY CURRENTS ARE PRESENT

be produced when 1 amp exists in the circuit and there are no core losses. The flux per ampere of magnetizing current, $\frac{\varphi}{I_f}$, is proportional to the actual reactance and is

$$\frac{\varphi}{I_f} = \frac{x}{2\pi fN}\,10^8$$

N is the number of turns with which the flux φ links. The flux per ampere is *not* equal *to the effective* reactance divided by $2\pi fN10^{-8}$.

For example, the following actual data are given:

$P = 345$ watts.
$I = 21.7$ amp.
$E = 25.7$ volts.
$r = 0.302$ ohms.

From this data:

$$R = \frac{345}{21.7^2} = 0.733$$

$$X = \sqrt{\left(\frac{25.7}{21.7}\right)^2 - (0.733)^2}$$

$$= 0.93.$$

From equation (5):

$$x = 0.93 + \frac{(0.733 - 0.302)^2}{0.93}$$

$$= 1.13$$

The actual reactance is about 22 per cent greater than the effective reactance in this case.

The magnetizing component of the current is given by equation (6).

$$I_f = 21.7\,\frac{0.93}{\sqrt{0.93^2 + (0.733 - 0.302)^2}} = 19.7$$

This is about 91 per cent of the actual current in the circuit,

It is perhaps interesting to know that the above data were taken when current was supplied to one phase of a three-phase alternator at standstill. This experiment is the basis for determining the reactance of the armature windings for various positions with respect to the field poles

Electric Locomotives for Swiss Railway

Single-phase, 15,000-volt, 15-cycle, 2500-hp units for use on the Loetschberg line operating through the Simplon Tunnel

AN outline of several experimental electrical locomotives for the Simplon Tunnel route of the Loetschberg Railway in Switzerland, together with a well-illustrated descriptive article relating to a 2000-hp, single-phase locomotive built by the Oerlikon company for this service, appeared in our issue dated July 29, 1911. As a result of the satisfactory operation of this locomotive the railway ordered thirteen additional locomotives of a similar type but somewhat larger for the Spiez-Brig high-speed passenger and freight service. On July 15, 1913, the electrical service was extended to Brig, and the new locomotives have been in satisfactory operation since that date.

Each locomotive is rated at 2500 hp, and at the normal speed of 31 miles per hour exerts a drawbar pull of 22,000 lb. It is provided with five intercoupled driving axles and two pony trucks.

In order to obtain flexibility on curves, the following axle arrangement has been adopted: The middle axle (driving axle) is given the extraordinary side-play of 0.98 in. (25 mm). The two adjacent axles are fitted without play into bearings fixed to the frame. The two end driving axles are said to have 1.57 in. (40 mm) side-play and are connected with the adjacent pony axles of the Krause-Winterthur pony trucks with sliding center pins and reaction springs. The pony axles therefore have even greater play, so that, notwithstanding the relatively great length of the locomotive, curves of 364-ft. radius may be taken without difficulty.

EQUIPMENT OF THE LOCOMOTIVE

The braking and signal equipment comprises Westinghouse automatic brakes, hand brakes, air sanders and air signal whistle. Compressed air is employed for the current collectors and for a part of the safety appliances such as door bolts and ladders. The compressed air is produced by two compressor sets with a common governor. A supplementary hand-operated air pump is provided for the initial lifting of the pantograph collectors.

The railway company required the electrical equipment to be divided into distinct duplicate sections, each half set being complete in itself. It is therefore possible to run with one-half of the equipment. Both equipments may also be run simultaneously either in series or in parallel. Moreover, the motors may be served individually by either of the two transformers. The locomotive is capable of developing full drawbar pull and speed continuously with one transformer, one controller and the two motors coupled in series.

Single-phase, 15-cycle alternating current at 15,000 volts is taken from the line by two pantograph collectors and conducted to the two halves of the electrical equipment through two protecting choke coils. The two high-tension switches are constructed as oil switches for distant and hand-operated control. They have maximum and minimum current cut-outs and are provided with rheostats to prevent heavy shocks when the transformers are switched into the circuit. The transformers are of the forced air-cooled type with the two high-tension coils connected in parallel. The coils of the low-tension side are connected in series and have twelve different steps of about 45 volts each for speed regulation from 90 volts to 520 volts. At full load with 420 volts at the terminals the motors take 2700 amp. The transformers supply current at 118 volts for the auxiliary motors and at 325 volts for the heating apparatus.

Each transformer carries integral therewith a voltage step switch, the contact points of which are directly connected with the low-tension taps of the transformer. In accordance with its position for the time being, the main cylinder connects two consecutive pressure taps with the two sides of an auto-transformer, the center of which is connected by way of its corresponding low-tension switch to one of the motor cables.

The step switches of the controller are constructed for distant and hand operation. They consist principally of a main cylinder, an auxiliary cylinder and driving gear. The main cylinder, which is connected with the voltage taps of the transformer, impresses the corresponding voltage on the auto-transformer. The auxiliary cylinder has a mag-

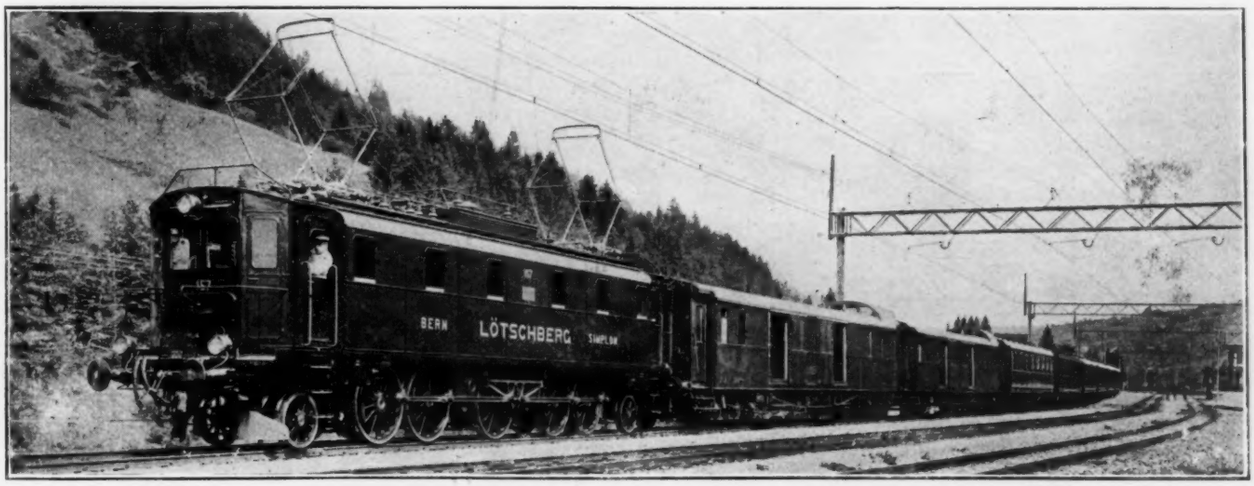


FIG. I—GENERAL VIEW OF LOCOMOTIVE AND CATENARY CONDUCTOR SYSTEM

netic blow-out and effects the making or breaking of one or the other of the auto-transformer circuits so that the changing over of the circuit, which is effected by the main cylinder, may be carried out while the current is cut off.

The controllers and the low-tension oil switches are constructed for a maximum motor current of about 3600 amp.

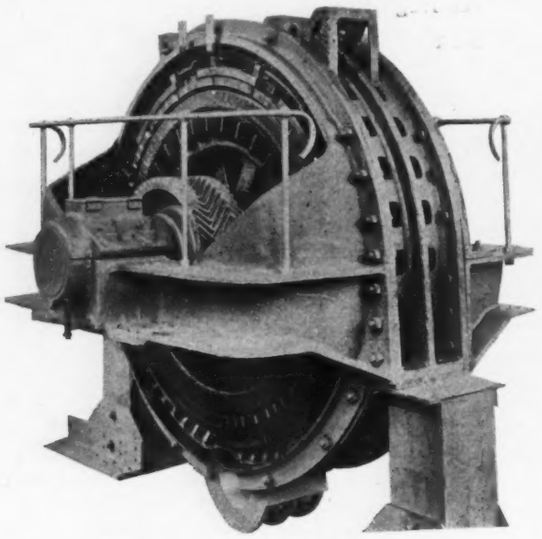


FIG. 2—1250-HP DRIVING MOTOR

FIG. 3—TRANSFORMER AND CONTROL EQUIPMENT

They can be switched on or off by hand as well as electrically from the engineer's stands. Between each of the low-tension oil switches and the motors a shunt is inserted to feed the maximum cut-out of these switches and the ammeter of the motors.

The two motors, which are rated at 1250 hp each on a one-and-one-half-hour basis, are of the compensated-series type with interpoles. Their weight, including the gearing, is 14 tons each. By means of a double helical cut gear of 1:2.23 ratio the motor drives a counterbalanced jack-shaft. The cranks on both ends of these jack-shafts are coupled to the cranks of the driving wheels by means of a triangular yoke. In this drive non-spring-mounted masses are almost entirely avoided. The vertical play between the jack-shafts and wheels is absorbed at the middle driving axle by a vertical sliding block or Scotch yoke.

The motors have sixteen poles and are of open construction so that they are practically self-ventilating. Their commutating fields give sparkless running even without resistances. The air-gap between armature and stator is 0.15 in. (3 mm). The motors are built for a maximum emf of 500 volts and take about 3000 amp at their maximum load. The motor room is ventilated by a ceiling fan which is placed above the motors. This fan drives the discharged air through the commutating-pole shunt resistors, which are likewise built into the roof in order to cool them thoroughly by constant air circulation.

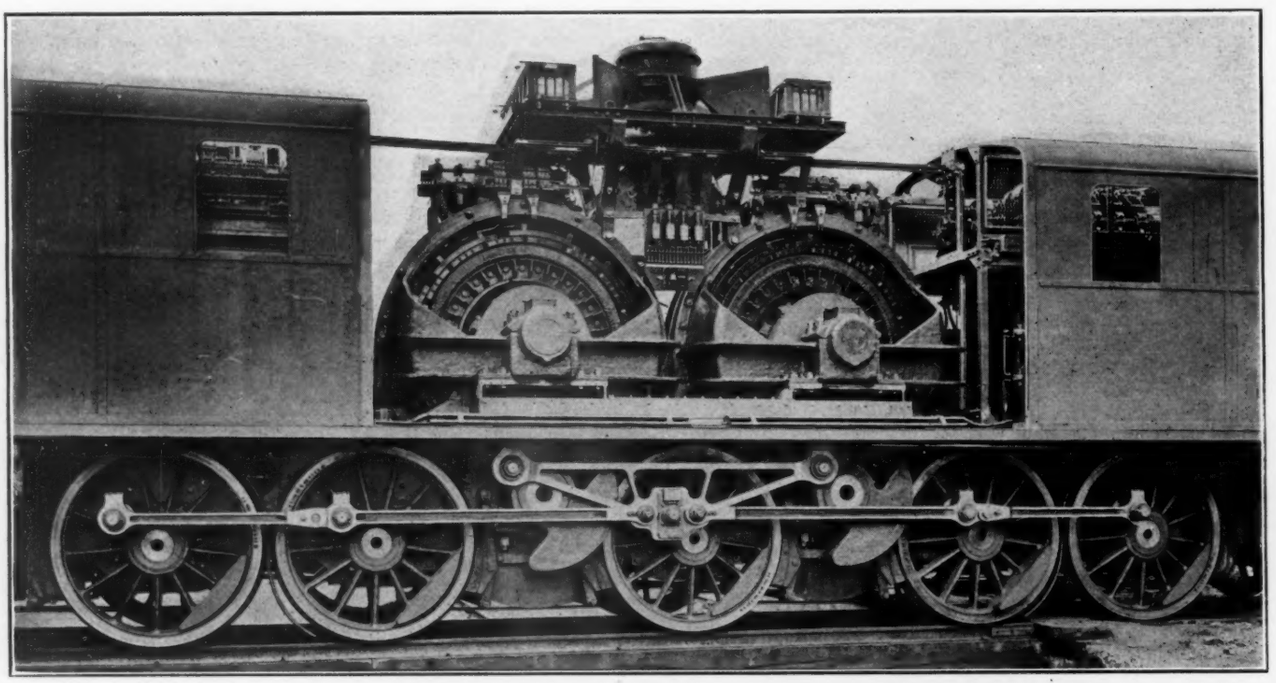


FIG. 4—VIEW OF DRIVING MECHANISM AND MOTOR MOUNTINGS

The normal speed of the locomotive is obtained at four times the synchronous motor speed. The tractive effort

and speed of the motor also ranges within wide limits independent of the line voltage, for on one hand care has been taken to compensate by suitable transformer taps any considerable decrease of line voltage, while on the other hand the motor can develop its full torque at a third of its normal voltage. Owing to this fact the motors also possess an enormous overload range at normal voltage.

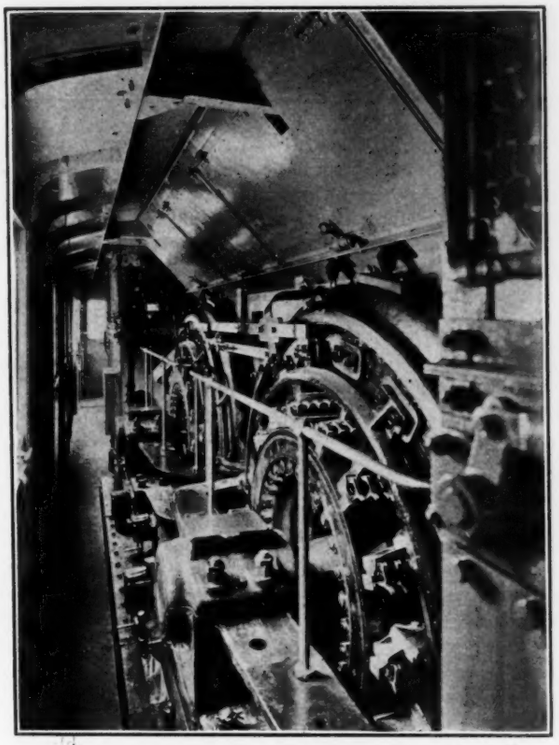


FIG. 5—INTERIOR OF LOCOMOTIVE CAB

The power-factor of the motors at all normal speeds is about 95 per cent. During trial runs the efficiency of the locomotive proper (transformer, motor, gearing, etc.) up to the wheel circumference has been found to be as high as 88 per cent.

A motor-generator set jointly with four ordinary train-lighting batteries supplies the direct current for remote control and lighting. After the motor and generator switches have been cut in by the engineer, all further alterations in the connections, such as paralleling with the batteries, are made by an automatic starter.

MOTORMAN'S CABS, HIGH-TENSION ROOMS, ETC.

The superstructure carries the two railway motors in the center, and the transformers, control, etc., are placed between the motors and the motorman's cab. For convenience in maintenance and repair, the roof over the motor room is fitted with two detachable trap doors, and the sides of the section are also removable. End and side doors are built in as shown in the side view of a locomotive.

Each motorman's cab contains the air-valve mechanism for operating the current collectors, two switches for operating the high-tension and low-tension switches, main controller handle by means of which the step contacts are manipulated, reverser at the right of the controller, signal lamps which show the engineer the running direction of the machinery, and two lamps which light up as soon as the contactors stand in the zero position. All switches are so interconnected, either electrically or mechanically, that wrong manipulations are impossible.

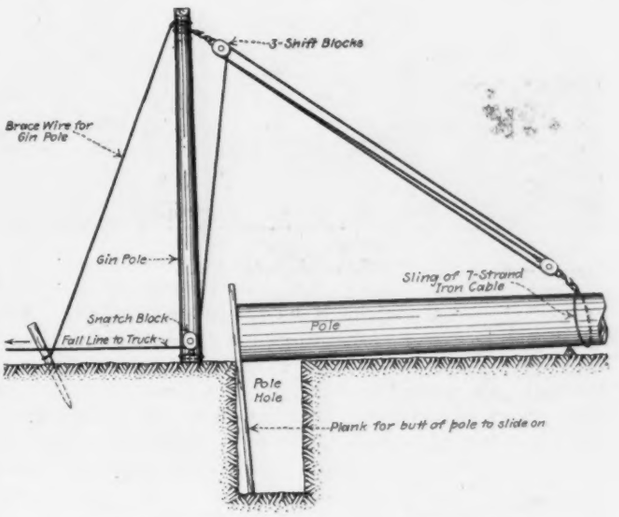
The two high-tension compartments in the motor room are shut off by doors of wire netting. These doors are so locked that prior to their being opened the high-tension conductor before and behind the high-tension oil switches must be grounded. The key which is necessary for the release of this lock is attached to the current collector valve conduit in such fashion that it can be taken off only when the collector valve is open, thus compelling the escape of any air in the conduit. With this key all the doors of the individual high-tension compartment can be unlocked, but it can be taken out of the lock only when all the doors are closed. This arrangement renders it impossible to open the high-tension compartment while the equipment is alive.

All of the mechanical parts of the thirteen locomotives were manufactured by the Schweizerische Locomotive & Maschinenfabrik, Winterthur. The contract stipulated that the electrical equipment of all locomotives should follow the plans and construction data of the Maschinenfabrik Oerlikon, regardless of the company which might be selected to assemble the locomotive. On this basis six of the equipments were made by Brown, Boveri & Company, Baden, and seven by the Oerlikon company.

Motor Truck Reduces Cost of Erecting Poles

Among the many uses to which motor trucks of central stations are put that of raising poles is one of the most novel. As shown in the accompanying drawing, a gin pole, snatch block and tackle equipment are the only other prerequisites. The butt of the pole which is set over the hole impinges against a plank as shown. With the gin pole set up and anchored to a convenient fence post or other solid projection, the block and tackle are attached near the center of gravity of the pole. When the fall line of the blocks is run through the snatch block and tied to the rear axle of the truck it is only a minute's work for the truck to raise the pole and let it fall into the hole. Two men with short pikes are generally necessary to keep the pole from swinging sidewise as it is raised. In case the pole is being raised between the wires of an existing line, the movement of the truck can be controlled so that the men with the short pikes can direct the course of the pole through the overhead wires.

The method described above was used in erecting heavy poles with 8-in. tops for a 35,000-volt transmission line near Marion, Ind., with the result that 60 per cent of the cost of raising the poles was saved. The construction crews of the Marion (Ind.) Light & Heating Company now resort to the old method of "piking in" the poles only when it is impossible to reach the line with the motor truck.



RAISING POLES WITH AID OF MOTOR TRUCK

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

37,000 Electric Vehicles

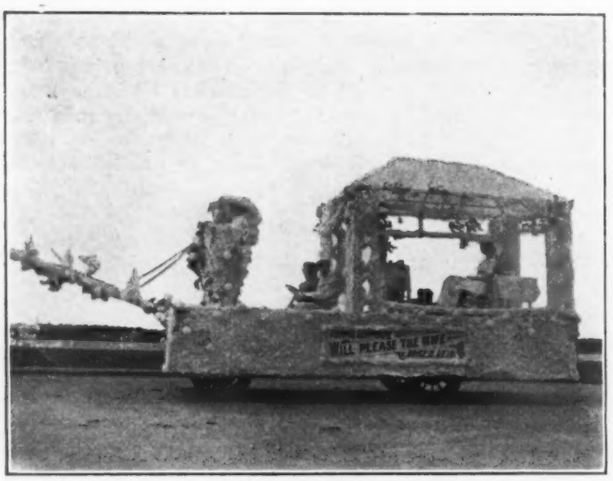
Thirty-seven thousand electric vehicles are in use in the United States, according to an estimate by Mr. Arthur Williams, president of the Electric Vehicle Association of America. Of this number 25,000 are probably pleasure cars and 12,000 are commercial wagons. Following are the numbers of electric vehicles in operation in some of the principal cities:

Chicago	2,850	Denver	887
New York	2,000	Boston	543
Cleveland	1,800	St. Louis	600
Washington	909	Columbus, Ohio	400

In Chicago electric trucking has increased 400 per cent in two years. In New York 40 per cent of the commercial power trucks are battery-driven. Nine of the New York hospitals use electric ambulances.

Electric Float in Elkhart Parade

During the recent Merchants' Fall Festival in Elkhart, Ind., there was a night parade of illuminated automobiles.



ELECTRICAL FLOAT IN ELKHART NIGHT PARADE

One of the most striking floats shown, and the one which was awarded second prize, was that of the Brice H. Reid Company, a concern engaged in electrical contracting and the sale of electrical supplies. In front were two urns in which were seated two little girls under canopies. Doves were represented hovering over the "bowsprit" of the float with ribbons attached to them as though they were drawing the vehicle. The greater part of the display was devoted to a demonstration of domestic uses of electricity under a graceful pavilion. A housewife was seen seated at her ease in a rocking chair while an electric washing machine was at work. An electric flatiron was at hand to be used when needed. Other devices, such as a chafing dish, coffee percolator, electric fan and reading lamp, were shown. A collie dog at the lady's feet added to the domesticity of the scene.

The float was decorated in white and lavender, relieved with green vines. It was illuminated by 140 small frosted incandescent lamps. There was a row of lamps around the tops of the urns and at the angles of the parasol canopies. Each of the six doves held a lamp in its beak. Electrical energy was obtained from storage batteries. The float presented a beautiful appearance and was greeted with hearty applause along the line of march.

A Sales Department's "Readiness to Serve"

Recently a severe electrical storm found the Detroit Edison Company with ten times the usual amount of trouble waiting to be cleared. The telephone department was unable to take the calls and the distribution force was inadequate in numbers and equipment to meet the situation.

The sales department thereupon tendered its assistance. Every available clerk in the sales department was put at a telephone or set to sorting and distributing trouble calls. Every sales-department motor car was turned over to the distribution forces, and soon every salesman was either driving a repair man or making repairs himself. "This was not outside of our regular work, as we recognize it," commented Miss S. M. Sheridan, sales manager of the company, "for the sales department is responsible, more than any other department, for good service to the company's customers."

Efficient Cost-Keeping Systems

One of the first principles of scientific management is that of planning and dispatching. In this connection the working out in advance of monthly requirements in the way of supplies and checking the same against records of previous use has been adopted by the Portland (Ore.) Railway, Light & Power Company. From these monthly estimates the purchasing agent is informed in advance of the requirements of all of the departments and can by lumping his staples secure the benefit of quantity prices and discounts. The general storekeeper has thus an opportunity to check and replenish his stock if he has not on hand a sufficient amount of the items estimated, or he does not need to order some item that is running low on the shelves as the estimate shows no immediate need for it.

In the department of wires and conduits a job system of unit costs has been adopted. Before any work is started an estimate covering the cost of such work is prepared, and if approved, the line foreman is notified. At the same time the cost clerk of the department of wires and conduits opens up a sheet in the line construction ledger that takes care of all items and labor costs of installation or removal. A daily segregated labor cost is obtained from the gang foreman's daily report, making it possible to analyze and distribute the expense on all jobs. This work is done by the cost clerks. The timekeeper has a check on them and makes all labor charges on jobs directly to a controlling account, covering the department of wires and conduits, this controlling account being on the books in the auditing department. The total charges against the controlling account must balance with the distribution of the jobs as turned in by the cost clerk. All items of labor, material requisitions, either storeroom or purchase orders, credit

memoranda for unused material and cartage costs are sent to the cost-keeping department and shown against each job separately. The same job system applies in the meter department, the trouble department, the department of arc lamps and the electrical-construction department.

By this system it has been possible to gather a great deal of valuable cost data on unit costs, which have disclosed some very startling things in the way of efficiency possibilities.

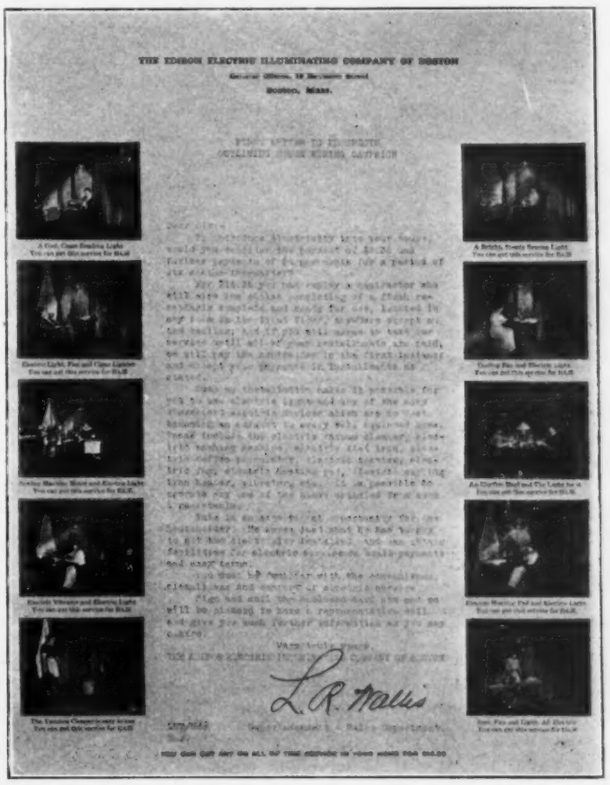
It has been said that "reliable records are the best means of locating faults; without them rule-of-thumb methods must apply."

Boston Edison House-Wiring Campaign

An active campaign for the wiring of old residences has lately been inaugurated by the Edison Electric Illuminating Company of Boston, Mass. The instalment plan is applied upon the basis of an initial payment of $2.35, followed by monthly payments of $2 each for a period of six months after the signing of the contract, and covering one outlet for a total of $14.35. Additional outlets are wired by accredited local contractors according to a carefully prepared schedule providing for various combinations as shown in the accompanying list. These prices apply only to "single apartments and dwellings and are based upon acceptance within thirty days from quotation and upon the use of armored cable and first-class workmanship throughout and complete ready for use, excepting fixtures, where deductions for fixtures are made; and also excepting private property construction in excess of one stretch of wire overhead, or where underground service is required in excess of 2 ft. inside the sidewalk line."

FIG. 1—FIXTURES OFFERED IN BOSTON EDISON HOUSE-WIRING CAMPAIGN

The price list was developed particularly to enable every employee of the company to figure the cost of house wiring upon inquiry, without the delay of securing an estimate from a contractor. The company holds the opinion that a rate of 10 cents per kw-hr. makes possible the conveniences of electricity in at least every home owned by its occupant, and to render the introduction of electric service still easier, the company offers to pay the contractor's bill in full, allowing the customer to meet the cost by the plan of instalment payments above outlined. The schedule of prices makes it possible for every employee to answer specifically just what it will cost to secure a partial or complete job, ready to use, in either case, including wiring, fixtures, shades, lamps and meter. No other information


THE EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON

Boston, Mass.

L. R. Wallis

FIG. 2—COPY OF LETTER USED IN BOSTON EDISON HOUSE-WIRING CAMPAIGN

is needed from the prospective consumer than an enumeration of the different rooms he wishes to have wired and the number of lighting outlets, switches and receptacles he plans to install. This offer is available only to prospective customers on existing commercial lines of the company or where extensions have been authorized, and all such contracts are passed upon by the credit clerk before being executed. Customers have the opportunity to extend their payments over periods to a maximum of twenty months in case their monthly payments exceed $5 maximum, shorter times being allowed for lower payments.

It is expected that very few contracts calling for but one outlet, at $14.35, will be made, and the effort of the employees is directed toward securing a complete wiring proposition by leading the applicant along step by step and showing him by detailed prices how much more can be secured by a little larger payment. Care is also taken to point out that the cost of a job is less if the whole number of outlets is installed at one and the same time.

EXAMPLE OF DETERMINING WIRING COST

The following example shows the application of the schedule to the wiring of a third-story apartment requiring the following equipment: Kitchen—one receptacle, one center lamp on pull-socket, no switch; parlor—one three-lamp fixture with pull-socket, no switch; hall—one single-lamp fixture on switch, one baseboard receptacle, one single-lamp fixture in hall closet, no switch; dining-room—one four-lamp fixture on switch; bathroom—one single-lamp fixture on pull-socket, no switch; pantry—one single-lamp

fixture on pull-socket; chamber—one three-lamp fixture with pull-sockets, no switch.

Applying the schedule:

One No. 11, less 1 switch (receptacle in kitchen, hall and parlor lighting)	$31.5J
One No. 17 (dining-room lighting)	12.00
One No. 18, less 1 switch (kitchen lighting)	5.25
One No. 19 (pantry lighting)	4.25
One No. 23, less 1 switch (bathroom lighting)	5.25
One No. 24 (hall-closet lighting)	4.25
One No. 24, less fixture, plus one No. 8 fixture (chamber lighting)	7.50
One No. 26 (hall-baseboard receptacle)	4.00
Two No. 28 (third-floor apartment)	10.00
Nine pull-sockets (kitchen, pantry, bathroom, parlor and chamber)	2.25
Total	$86.25

This amount, $86.25, divided over eighteen months, would average payments of $4.79 per month and leave a balance of 3 cents due. The proper disposition of such an account would therefore be either a first payment of $5.50 and $4.75 per month for seventeen months, total $86.25, or $6.25 at signing of agreement and $5 per month for sixteen months, total $86.25.

To arouse the interest of prospective customers in the campaign, the company recently prepared and sent out individually addressed letters as reproduced herewith, showing what can be accomplished for the basic investment of $14.35. On the border of the page are reproduced ten photographs taken at the House of Edison Light, each view showing the service which may be secured from a single outlet with from one to three sockets. A card is inclosed with each letter to facilitate the customer's getting in touch with the company's representative.

SCHEDULE OF WIRING PRICES

No. 1—Outlet consisting of a flush plug receptacle located in any room on the first floor anywhere excepting ceiling	$14.35
No. 2—No. 1 and outlet in cellar at heating apparatus with switch	19.00
No. 3—No. 1 and 1 outlet on piazza with switch in hall and fixture	22.00
No. 4—No. 1 and 1 outlet in hall with switch and fixture (three-way switches $6 additional)	23.00
No. 5—No. 1 and 1 outlet in parlor with switch and fixture	25.50
No. 6—No. 1; No. 2; No. 3	27.00
No. 7—No. 1; No. 2; No. 4	28.00
No. 8—No. 1; No. 2; No. 5	30.50
No. 9—No. 1; No. 3; No. 4	31.00
No. 10—No. 1; No. 3; No. 5	33.50
No. 11—No. 1; No. 4; No. 5	34.50
No. 12—No. 1; No. 2; No. 3; No. 4	36.00
No. 13—No. 1; No. 2; No. 3; No. 5	38.50
No. 14—No. 1; No. 2; No. 4; No. 5	39.50
No. 15—No. 1; No. 3; No. 4; No. 5	42.00
No. 16—No. 1; No. 2; No. 3; No. 4; No. 5	47.50
Additions (to apply only after No. 3):	
No. 17—Dining-room outlet with switch and fixture	12.00
No. 18—Kitchen outlet with switch and fixture	8.25
No. 19—Pantry outlet and fixture	4.25
No. 20—China-closet outlet and fixture	4.25
No. 21—Back porch outlet with switch and fixture	8.00
No. 22—Second-story hall outlet with two three-way switches and fixture	11.25
No. 23—Bathroom outlet with switch and fixture	8.25
No. 24—All other lighting outlets with fixtures each	4.25
No. 25—All other switches, each	4.00
No. 26—Floor or baseboard receptacles, each	4.00
No. 27—Bell-ringing transformer	4.00
For each additional floor above the first floor:	
No. 28—Add $5 for Item No. 1 (extra charge is to provide for running risers through additional floors).	
No. 29—Add $10 for Items No. 1 and No. 2 (extra charge is to provide for controlling cellar lighting from the floor occupied by the user).	
Deductions if not wanted:	
Switches (exclusive of cellar switch), each	3.00
For fixtures if personal selection is desired:	
Nos. 3 and 6, each	1.00
Nos. 18, 19, 20, 21, 22, 23, 24, each	1.25
Nos. 4 and 6, each	2.00
Nos. 5 and 8, each	4.50
Nos. 9 and 12, each	3.00
Nos. 10 and 13, each	5.50
Nos. 11 and 14, each	6.50
Nos. 15 and 16, each	7.50
No. 17	5.00

Results of Denver Group Appliance Sale

During the spring of the present year (as noted in our issue of June 21, page 1368), the Denver Gas & Electric Light Company inaugurated an appliance-sales campaign which proved very effective in adding load to its lines, while at the same time reducing by two-thirds the usual sales cost of placing such devices. Coupons like that reproduced herewith were distributed among the company's household customers, each coupon entitling the recipient to $11 discount on his choice of any of the twelve fifty-dollar groups of appliances offered. Each group comprised three appliances (such as vacuum cleaners, electric irons, toasters, curling irons, etc.) and would ordinarily have sold at $50. Besides the $11 discount represented by the coupon, the purchaser was allowed to pay the remaining $39 in monthly instalments of $3 each, so that from the customer's standpoint the offer was an attractive one.

Approximately 1000 appliances were sold during this campaign—a record which exceeded that for any other month, although December is usually the best. The appliances thus put in service represent an additional load of

THE DENVER GAS & ELECTRIC LIGHT CO.
THIS COUPON IS GOOD FOR $11.00
TO APPLY ON THE PURCHASE PRICE OF ANY ONE OF THE GROUPS OF APPLIANCES DESCRIBED ON THE OTHER SIDE OF THE CERTIFICATE. GOOD ONLY DURING THE MONTH OF SEPT. 1913. THE APPLIANCES ARE MADE BY THE LEADING MANUFACTURERS OF THE COUNTRY AND HAVE OUR GUARANTEE BEHIND THEM. BY PRESENTING THIS COUPON WHEN YOU PURCHASE YOUR CHOICE OF THE GROUPS, YOU ARE GIVEN THE PRIVILEGE OF EASY PAYMENTS. $3 DOWN AND $3 A MONTH. THOSE WHO WISH TO AVAIL THEMSELVES OF THE EASY TERMS ARE THUS GIVEN PLENTY OF TIME IN WHICH TO PAY FOR THEIR APPLIANCES.

COUPON USED IN APPLIANCE SALES CAMPAIGN, DENVER, COL.

about 150 kw, which is distributed throughout the system. Similar sales were also conducted in June and September when gratifying results were again obtained. By the plan of grouping the appliances it was found that three devices could be sold with the effort ordinarily exerted in disposing of but one.

Utilizing the Vacant Store Window

A novel use for vacant storerooms which accomplishes the triple result of "boosting" the local standard of window illumination, aiding central-station appliance sales and helping to rent the premises for the owner, has been discovered by the Joplin (Mo.) office of the Empire District Electric Company.

From real-estate dealers having charge of tenantless business property permission is obtained for the central-station commercial department to equip the vacant show windows with displays of electrical appliances, each window being brilliantly lighted from the lines of the company. In a prominent position in each lighted window the agent's rental sign and address are also displayed on a large placard. Another legend used with success has been a card stating the cost per hour of the window lamps.

The real-estate man benefits, of course, from the brightly lighted and attractive condition of his premises, which draws the attention of many possible tenants who would otherwise pass without noticing his sign. Storerooms in which these electrical displays are installed do not remain tenantless long, which seems to be the only drawback to the plan, but as no expense is involved except that of decorating each new window in turn, the electric company profits by a wide margin from the publicity obtained. In a number of instances it has also disposed of the window installation outright to the new tenant.

Illumination and Wiring

Electric-Lighted House Number

The electric-lighted house number shown in the illustration was devised by Mr. Charles M. Retts, a contractor of Tropico, Cal., and is in use on one of Tropico's bungalows, its design conforming to the Mission lines of the structure. In addition to showing the number of the house both by day and by night, the device serves also as a porch lamp.

ELECTRIC-LIGHTED HOUSE NUMBER

The framework and roof of the lamp housing are made of lacquered brass, as are the figures, which are about 5 in. high. Panes of frosted glass are placed inside this framework on the sides, front and bottom, making the number equally visible by day and night. The box portion is 10 in. long and 4.5 in. wide, while its height at the front is 6 in. and at the back is 8 in. The brass roof has an extension of 1.5 in. at the front and 1 in. at the sides. A 16-cp lamp is used, although any size of unit might be employed, depending on the intensity of porch illumination desired.

Lightning Protection in the Cripple Creek District

At the recent convention of the Colorado Electric Light, Power and Railway Association Mr. Charles Neely, of the Arkansas Valley Railway, Light & Power Company, read a paper on "Lightning and Lightning Arresters in the Cripple Creek District." In that section one of the greatest problems confronting the electric-service man is the severe lightning. It is not unusual to have sixty bad storms between June 1 and Sept. 1. At an altitude of 10,000 ft. the lightning is very severe and direct strokes to the transmission lines are not unusual. During one storm in the summer of 1913 there were fifty-six discharges over one set of aluminum arresters. This type of arrester is used quite extensively, but is rather expensive for general installation on 6600-volt lines, so that considerable experimenting has been done with horn-gap arresters connected directly to ground. The gap of 1.25 in. formerly in use was found to be too wide and a gap of 0.875 in. was substituted with excellent results. Mr. Neely reported that not a single piece of apparatus was lost during the summer of 1913 on the 6600-volt service where horn-gaps set at 0.875 in. were used.

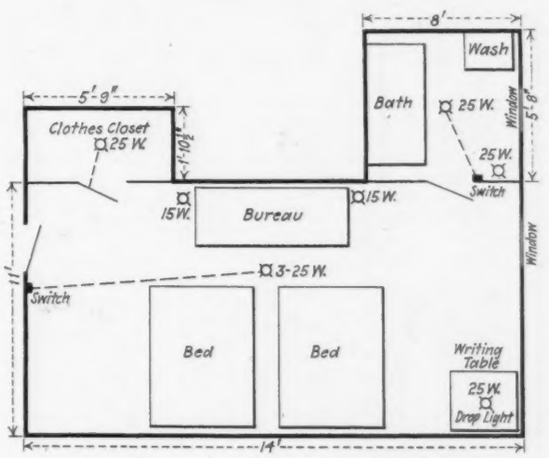
About Aug. 1 a set of horn-gaps with a 3-in. space was installed on a 20,000-volt circuit as an experiment. Each gap was fused on the grounded side. The use of these protectors has resulted in but one interruption to service. However, Mr. Neely does not believe that horn-gaps are practicable on 20,000-volt circuits except with the wide gap for direct strokes to the line. For lower voltages, however, he thinks there is no doubt that the horn-gaps can be used very successfully. It has been found that the number of arresters in use on the 2300-volt circuits was much too small and the same was true of the 500-volt service. In the case of 500-volt circuits it has been found that by installing the arrester at the motor with a choke coil, rather than placing it on the pole near the motor, better protection is secured.

A Study of Hotel-Room Lighting

In view of the poor standards of illumination still in vogue in many hotels and the need of better service as a direct factor in patronage, the accompanying rough diagram of a first-class modern installation in a recently completed house is suggestive. The example selected is one of the lower priced rooms, which is taken for the reason that its lighting arrangement may be duplicated or paralleled elsewhere in older hostelries with less difficulty than had an expensive suite been taken.

The room is finished with light brown walls, the woodwork being of mahogany stain. The chamber proper is 14 ft. long by 11 ft. wide, with an adjoining bathroom 8 ft. long by 5 ft. 8 in. wide and a clothes closet 5 ft. 9 in. long by 1 ft. 10½ in. deep. The general illumination of the room is supplied by a cluster of three 25-watt tungsten lamps installed 18 in. below the ceiling, the latter being 10 ft. 6 in. high. These lamps are controlled by a push switch located inside the door. On each side of the bureau a 15-watt lamp is installed at a height of 5 ft. 6 in. above the floor, providing ample light for use at the mirror. In the further corner of the room a writing table is equipped with a screened drop lamp of 25 watts rating, supplied with energy from a baseboard outlet behind the table. The closet is automatically illuminated by a switch actuated by the door, a single 25-watt lamp on the ceiling being thrown into circuit when the door is opened. The walls of this closet are painted white and two shelves are provided running through its entire width.

The bathroom ceiling is 9 ft. 6 in. high. In a central position is installed a 25-watt lamp for general illumination, housed in a pear-shaped alabaster shade and carried 6 in. below the ceiling. The lamp is controlled from a push switch located inside the door. There is also a 25-watt bathroom side lamp at a height of 6 ft. above the floor, just inside the door and opposite a large mirror installed over the wash basin. This lamp is controlled by a chain-pull switch. Although no illuminometer measurements are available, the lighting service furnished by this installation leaves little to be desired. With all lamps cut out except the drop lamp on the writing table it is possible to read or write in one corner of the room without the least disturbance to a guest occupying the further bed, and the placing of the utility lamps within reach of the hand has reduced the switch wiring cost materially below that which might be anticipated from the number of units installed.



SCHEME OF HOTEL-ROOM LIGHTING

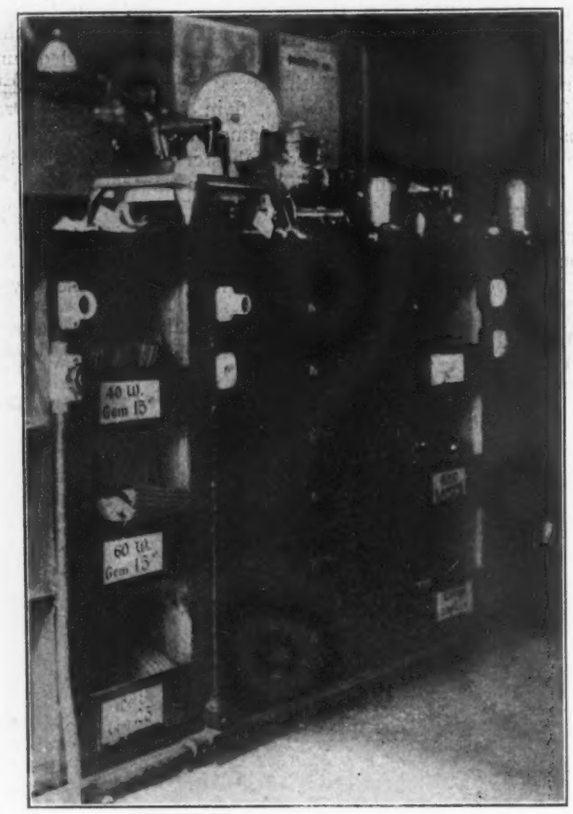
Indirect Train Lighting to Be Supplemented for Readers' Use

The indirect-lighting system of the Merchants' Limited, the New Haven Railroad's "crack" train between Boston and New York, is to be supplemented by the addition of direct tungsten units along the side beams of each car. This will increase the light available for reading purposes, concerning which there has been complaint.

The present equipment of this train (see *Electrical World*, April 26, page 888) was the first turned out by the Pullman company in which use was made of indirect lighting. When first installed each of the ten inverted fixtures suspended from the ceiling of the 72-ft. steel parlor cars contained one 100-watt tungsten lamp. By displacing each of these units with three 50-watt lamps an increase of 50 per cent in illumination was obtained, but even with this improvement some of the regular passengers complained of difficulty in reading in the soft light that pervades the cars, and the additional tungsten units have now been ordered installed.

Wiring a Counter at Low Cost

To facilitate the testing of lamps and small energy-consuming appliances at the counter of its commercial department, the Manchester (N. H.) Traction, Light & Power Company has wired the rear of the counter in conduit as shown in the accompanying illustration, the outlets being in condulet fittings about 3 ft. 6 in. above the floor. In



CONDUIT WIRING FOR TEST OUTLETS

many central-station offices such counter wiring is of the open type run under a display counter or open shelf. The arrangement shown is by no means novel in principle, but it illustrates the compactness of conduit work in a location where every cubic inch of space is valuable and where projecting conductors would be objectionable. The location of these outlets directly behind the counter saves time in demonstration, avoids fire risk and enables about a dozen appliances to be tested at the same time. One of the outlets is connected with a Donkin "cent-hour" meter, so that the cost of operating any device can be determined at a moment's notice on either of the company's rate schedules, the meter dial being calibrated for two rates in red and black scale graduations.

Private Street Lighting on North Clark Street, Chicago

The first installation of the new and artistic "Chicago" street-lighting posts for curb lighting has been put in service by the Commonwealth Edison Company on North Clark

FIG. 1 AND 2—"CHICAGO" LAMPS AND PRIVATE STREET LIGHTING ON NORTH CLARK STREET, CHICAGO, ILL.

Street, in the outlying district known as Summerdale. There are about eighty posts spaced 40 ft. apart on both sides of the street. The standard is of recent and handsome design and has been approved by the Department of Electricity of the city of Chicago and various other municipal bodies. The height over all is 14.5 ft. and the height from the ground to the center of the side lamps is 12 ft. The octagonal base has a diameter of 21 in. and the overall diameter of the ring of lamps is 27 in. This fixture is equipped with a 60-watt tungsten lamp in each globe. The top globe is 14 in. in diameter and the others are 10 in. in diameter.

Experiments with Cheap Pole-Line Construction at Cleveland

The Cleveland (Ohio) Electric Illuminating Company will soon begin the construction of an experimental pole line for the purpose of determining accurate costs on distribution lines serving small customers. The officials of the Cleveland company have been deeply impressed by the data on inexpensive wiring and European methods of handling the small customer collected by Messrs. S. T. Doane and Hugo Eisenmenger, of Nela, near Cleveland, and the erection of the experimental distribution line is to be the first step in determining how practicable are these methods in solving Cleveland's problems.

According to present plans, the line will be rebuilt several times on property belonging to the company. From the different resulting costs it will then be possible to determine what type of construction is most inexpensive. If the least expensive equipment can be built at a price which will enable the company to serve the small customer in the outlying territory at a profit, this type of construction will be standardized for such lighting extensions.

Recent Telephone Patents

A patent granted to Messrs. C. E. Egner and J. G. Holmstrom, of Sweden, relates to a transmitter designed to carry very heavy currents and provides means for keeping the transmitter cool by backing the microphone button with a vessel containing liquid for carrying off heat.

Mr. E. M. Schollenberger, of Chicago, has invented a telephone muffler consisting of a large double cone with abutting bases. The apex of one cone is drawn out into a lip-piece shaped to fit the contour of the face of the user, while the other incases snugly the transmitter mouthpiece.

Letters to the Editors

High-Frequency Generator

To the Editors of the Electrical World:

SIRS:—On page 913 of your issue dated Nov. 1 appears an abstract of an article by Mr. Ricardo Moretti on a new high-frequency generator for wireless work, in which is described a method which, aside from the details of the gap, is the same as one covered by United States patent No. 730,753, granted to Reginald A. Fessenden on June 9, 1903, a little over ten years ago. It may interest some of your readers to know the above in connection with this supposedly new development.

While there may be some advantage in the form of gap employed by Mr. Moretti, in that he may work at larger power, and possibly with greater regularity, still it should be noted that the method of operation is identically that disclosed in the above-mentioned patent.

S. M. KINTNER,
Pittsburgh, Pa. *National Electric Signaling Company.*

The Elevator as a Central-Station Load

To the Editors of the Electrical World:

SIRS:—When we look back upon the buildings of two or three decades ago—none of them more than a few stories in height—and then turn to the skyscrapers of to-day we marvel at the one thing that has made this great growth possible—the electric elevator.

Beginning with the installation of the first electrically operated elevator up through its various improvements until the present time, the electric elevator has set the pace in building construction. With each improvement of this type of elevator buildings have increased in height until now the skylines of our cities are marked by many massive structures each of them housing thousands of people and having an energy consumption equal to that of a small city. Without the elevator this enormous and intensified consumption of electric energy in limited territories would have been impossible.

To-day this subject is of special interest, in that in the highest building of the world passengers are transported directly in a single shaft to the fifty-fourth floor, a distance of 689 ft., a height a few years ago deemed impossible, while the latest type of electric elevator, embodying the traction principle, is capable of reaching any height the architect will essay.

In the distribution and movement of the congested population of a great city, especially in its business centers, vertical transportation now plays a most important part; for not only has the elevator made possible the skyscraper, but it is no less essential to the office, department store, warehouse, loft and apartment building of more modest height. As an example of the growth of elevator traffic, it has been estimated that the daily elevator traffic in the large cities outnumbers that of the traction companies nearly two to one, and while this work is widely distributed, yet the volume of traffic, if not the actual mileage, makes a most interesting transportation problem, which parallels that of the ordinary railway.

From the standpoint of the central station, however, the elevator is of vastly more importance than the railway, for while the latter derives its energy from its own generating plant, the former usually obtains its supply from the central station, and every electric elevator that is installed is a steady energy consumer—an ideal consumer in the fact that it operates chiefly during the daylight hours. In the last few years the number of electric elevator installations has increased surprisingly, owing to the increased economy and efficiency of operation of the electric-elevator machine.

The aggregate energy consumption assumes vast proportions when we consider the great number of electric elevators already installed as well as the almost unlimited field for future growth. Of equal importance to the central station, aside from the big possibilities for new business afforded by the electric elevator, is the vast saving brought about by the vertical building growth made possible by the electric elevator. Cities can expand in only two directions, horizontally and vertically. The elevator by enabling cities to grow upward has been the means of saving the central stations millions of dollars' investment in underground plant which would have been necessary in case of horizontal growth alone to secure the same business they enjoy to-day.

So much for the vertical elevator. There is another type of motor-driven elevator, known as the inclined elevator, which is being installed in factories of every type and description where, in the course of manufacture or shipment, the product must be moved from department to department or from floor to floor. This type of elevator, because of its economical and efficient handling of constantly increasing output, due to its continuity of motion—it is a continuous carrier, in the form of an endless moving chain—bids fair ultimately to find a place in every factory. The inclined elevator is also being used at docks to load and unload ships and in department stores to move packages from the shipping room in the basement to the sidewalk, ready for delivery. There are several types of the inclined elevator covering a wide range of applications, which makes it possible for this elevator to meet every condition of internal traffic service. The factories, department stores, docks and railroad terminals where the freight-handling expense can be reduced by the installation of a motor-driven inclined elevator are practically numberless.

The escalator, which operates on the same principle as the motor-driven inclined elevator but which is used for carrying passengers instead of freight, is another type of elevator which is fast gaining ground for use in public buildings. The escalator also covers a wide range of applications. It is being used in department stores, at elevated-railway stations, railway terminals, theaters, amusement parks and hotels for handling the passenger traffic. Installations have also been made in factories to move employees at morning, noon and evening.

In hilly districts the development of real estate with a subsequent increase in the consumption of electric energy is being greatly enhanced by the use of inclined railways for transportation of passengers and vehicles from one elevation to another.

The possibilities for new energy supply business through the installation of the above types of electric elevators merit the efforts of the central station to increase the number of electric elevators on its circuits.

With the co-operation of every central-station man in the educational and development work now being done to increase the use of electricity for domestic and industrial purposes, the elevator field is sure to attain the importance it deserves.

R. W. CHARLES,
New York. *Otis Elevator Company.*

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Oil-Burning Furnaces—I

By R. T. Strohm

The arrangement of the furnace of a boiler that is to be fired with oil fuel varies according to the type of boiler and the location of the burner; also, it makes considerable difference whether the boiler setting is originally planned for the use of oil fuel or whether it is altered from the coal-burning type. Details of the arrangements will differ

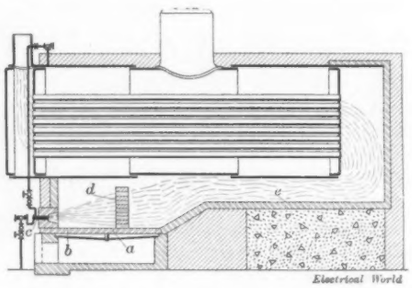


FIG. 1—RETURN-TUBULAR BOILER WITH KIRKWOOD OIL BURNER

because of the manner in which the air supply is allowed to enter. In view of these facts, it would manifestly be impossible to illustrate all of the many styles of furnaces, but several of them will be given to show their distinctive features.

A form of oil-burning furnace for a return-tubular boiler is shown in section and in plan in Fig. 3. There is a single fan-tailed burner *a* installed in the center of the fire-door. It projects well through the front wall and is surrounded by a short firebrick sleeve or arch *b*. The grates *c* are retained, and on them is laid a closely fitted layer *d* of firebrick that prevents air from rising through the grates except at the extreme rear end. On this layer of brick are placed a number of blocks that support another layer *e*, and this top layer forms a continuous floor from the arch *b* to the top of the bridge wall *f*. The air supply

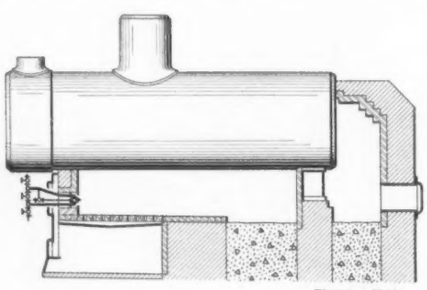


FIG. 2—RETURN-TUBULAR BOILER WITH BEST OIL BURNER

is admitted through the door *g* to the space beneath the grates, whence it flows to the rear, up through the grates, forward between the firebrick layers *d* and *e*, and then past the burner into the combustion chamber, as indicated by the small arrows. The arch *b* and the layer *e* of firebrick are kept at the point of incandescence by the flame from the burner, and the air in flowing along in contact with the hot brickwork becomes heated to a high temperature before it reaches the tip of the burner. This preheating of the air supply adds to the efficiency of the combustion. All joints or openings around the burner are carefully closed, so that no cold air can leak into the furnace. The entire air supply must therefore pass under the heated slabs *e*.

A return-tubular boiler arranged to use a Kirkwood burner is shown in section in Fig. 1. In this case the grate bars are retained but are covered with a closely laid floor *a* of firebrick that has a single slot *b* for the admission of air to the furnace from the ashpit. The burner *c* is set in firebrick in the fire-door opening and the slot *b* is just in front of it. The air on meeting the oil spray unites with it and the flames are thrown toward the rear, where they strike the firebrick pier *d* built on the grates. This pier is not solid, but forms a sort of checkerwork by which the burning gases are thoroughly diffused and mixed so

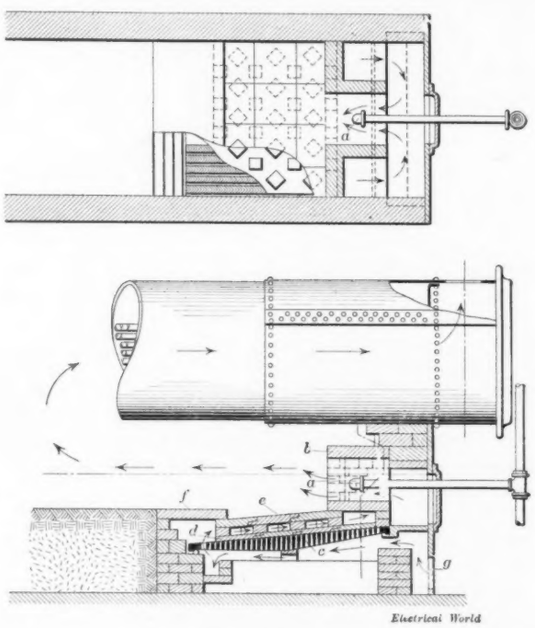


FIG. 3—RETURN-TUBULAR BOILER WITH SLOT OIL BURNER

as to prevent the possibility of incomplete combustion. Beyond the bridge wall the floor *e* is brought level with the top of the bridge wall, so that the hot products of combustion are kept in close contact with the boiler shell. With this arrangement the flames are directed against the firebrick on the grates and that forming the pier, but not against the boiler shell.

The arrangement suggested for a return-tubular boiler fitted with a Best burner is shown in Fig. 2. The bridge wall is torn down until its top is level with the surface of the grates. On this surface firebrick is laid flat, with air spaces about ½ in. wide in the part on the grates. The burner is inserted in an opening in the front wall of the setting, on the center line of the furnace. Its tip is about 8 in. above the firebrick on the grates and about 2 in. inside the front wall. The flame is thrown out parallel to

the grate surface and to the full width of the furnace. The air supply passes up through the openings in the brickwork covering the grates and mixes with the vaporized oil at all parts of the furnace.

The furnace arrangement shown in Fig. 5 is for a Babcock & Wilcox water-tube boiler. The grates are covered with a single layer of firebrick *a* laid close together except at the front, where a series of openings *b* are left. The burner *c*, which throws a fan-shaped flame, projects through the fire-door and its tip is just inside the front wall. Thus the flame from the burner is directly above the openings *b* in the brickwork. The air supply in this case is not preheated to any great extent, because it flows into the ashpit through the door *d* and passes immediately to the combustion chamber through the openings in the grates. The slot in the end of the burner is horizontal, and the sheet of flame thus produced is practically parallel to the surface of the grates.

The arrangement shown in Fig. 4 is also for a Babcock & Wilcox boiler. It differs markedly from that previously illustrated in that the burners are located at the back of the furnace, against the bridge wall, instead of at the front. The grates are removed completely and a firebrick floor *a* is built to cover the entire area from the front wall to the bridge wall. As may be seen in the plan view, this floor is carried by the side walls of the furnace and by the three sets of bearing bars *b* that rest on the side walls and on two longitudinal piers. The burners *c* are set in recesses in the front face of the bridge wall, just above the level of the floor, and are of the Hammel type. They direct fan-shaped flames forward over the flat floor *a*. The three passages formed beneath the bearing bars contain the oil and steam pipes leading to the burners and also serve as air ducts by which the air supply is led to

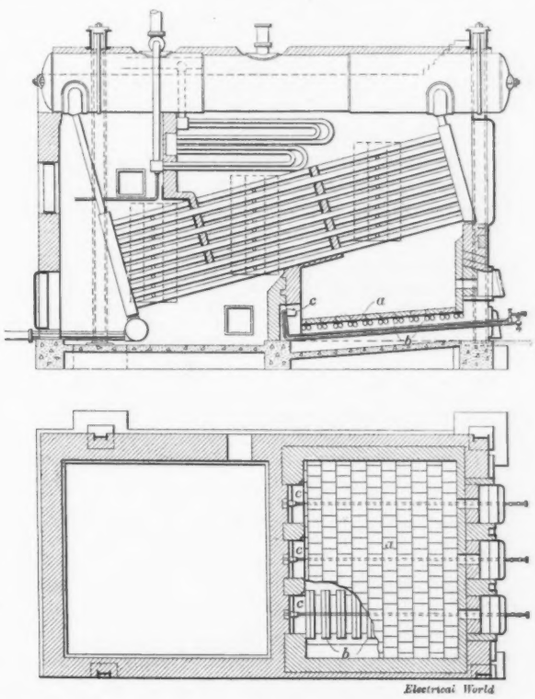


FIG. 4—BABCOCK & WILCOX BOILER WITH OIL BURNER AT BRIDGE WALL

the burners. Inasmuch as the floor *a* is kept incandescent, the air flowing along beneath it is heated highly before being allowed to flow upward past the burner into the furnace.

The three transverse rows of firebrick just in front of the burners are not laid end to end, but small spaces are left, in order that some of the air may rise directly through these openings and mingle with the oil vapor above the floor. This is done to prevent carbon from being deposited on the brickwork just below the tips of the burners. To the remainder of the floor *a* a coating of fireclay wash is given to fill up all joints and prevent air from flowing up through except as provided by the slots. The passage for each burner is separate from the others, and the

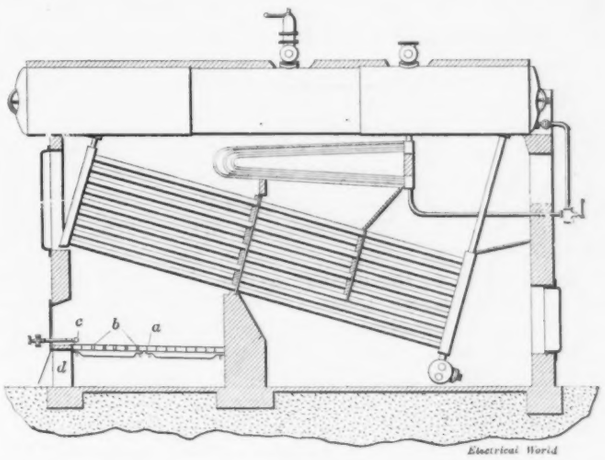


FIG. 5—BABCOCK & WILCOX BOILER WITH OIL BURNER IN FRONT

air supply to each burner can therefore be regulated by the ashpit door, independently of the others.

The object to be gained by placing the burners at the bridge wall and directing the flames forward is a better utilization of the combustion space. When the air and the gasified fuel unite and burn, the heat generated causes the temperature of the gases to rise, and they expand in volume as a consequence. By having them projected toward the front of the furnace, where the area of vertical cross-section is greater because of the upward slant of the tubes, the increased volume of the gases is accommodated by the increased space and the rate of flow of the products of combustion is thus rendered more nearly uniform. It will be observed that the front wall of the furnace is protected from the heat of the flames by a firebrick lining.

Short-Circuited Slip-Rings

Induction motor rotors are either of the squirrel-cage or of the defined pole type. The former are bar-wound and the ends of the bars are soldered, bolted or electrically welded to end rings, while the latter have insulated windings through which the path of the induced current is well defined; hence the name. Motors of the squirrel-cage type do not admit of liberal speed control, because the winding circuits are closed and do not therefore permit of resistance changes while in operation. On motors of the defined pole type the ends of the rotor coils may be permanently connected to a resistor that rotates with the rotor or they may be connected to slip-rings on which bear the brushes that lead to an external resistor. In either case the rotor resistance can be varied by means of a suitable resistor that is cut out on the last controller notch or position.

An inspector was called in to locate the trouble on a slip-ring motor that ran at the same speed on all notches. Inspection showed that the rotor brush pigtail shunts of each brush-holder had impinged against the adjacent holder and had welded there. This permanently cut out the external resistor, which, therefore, had no effect upon the speed, the rotor operating as a plain squirrel-cage rotor, and as it was not designed to stand such operation, it was

heating more than it should. On a motor of the internal rotating resistor type the same result obtains if the resistor units become short-circuited, as in such a case the short-circuiting shoe has no effect. Another advantage of the defined pole rotor is that it requires less current to produce a given torque and, therefore, causes less disturbance on the line from which lamps may be supplied. For a given rating a motor with a defined pole rotor will be larger than one with a squirrel-cage rotor, because more room is required for insulation and for heat radiation.

Hazard Due to Starting Diesel Engines with Compressed Oxygen

Widespread attention was attracted by the fatal explosion of a 50-hp Diesel engine at Bray, Ireland, in July of last year, while being started on compressed oxygen. In an analysis of the disaster by the British inspector of factories just issued some significant lessons are drawn concerning this practice of starting Diesel engines.

The engine had previously been shut down and overhauled, but when ready to resume operation it was found that the charges of compressed air required for starting had been lost from the three air vessels. It was therefore necessary to resort to some other compressed gas for starting, and following the instructions of the manufacturers to use "carbonic-acid gas or oxygen," a tank of oxygen at 1800 lb. pressure was secured from a chemical manufacturer and connected to the compressor line of the blast vessel.

Meanwhile the fuel pump had been filled with kerosene, and the operators proceeded to manipulate the valves in the usual method of starting. The engine had begun to move and seemed to run quite satisfactorily when the chief engineer advanced the lever from the starting to the running position. No firing stroke followed but air was heard escaping with a hissing sound. At the next instant an explosion occurred at the fuel valve on the cylinder and a blue flame was seen to travel along the blast pipe to the blast vessel, causing the latter to explode in turn with great violence. The flying fragments caused the death of the head fitter and injured the chief engineer so badly that both legs had to be amputated. The assistant engineer sustained severe burns, and considerable damage was done to the station.

From his examination at the scene of the accident the factory inspector concludes that the principal explosion was due to ignition of the oily deposit in the interior of the blast vessel, its destructive power being increased by the large volume of compressed oxygen present. The oily deposit referred to was probably derived from the lubricating oil used on the compressor piston, which came over in the form of vapor and was condensed in the blast vessel. The vessel at Bray had been in use two years and during all this time had never been scraped or cleaned. The metal was lined with a bituminous coating which probably contributed to the explosion. The prime cause of ignition the inspector traces to the kerosene and its low igniting temperature especially when in a finely divided condition. In the course of the present inquiry he reports discovering at least two other cases where Diesel engines exploded while being started on compressed oxygen.

The inspector advises that compressed oxygen or combustible gases like hydrogen should never be used for starting Diesel engines, and that special warnings on these points be issued by the makers of such engines. Traces of oil vapor should also be removed from the compressed air, so far as possible, before it passes into the blast vessel. Such air vessels should be cleaned and examined internally at least once a year, and also tested hydraulically once in four years.

Use of Fuller Board in Electrical Machinery

Is fuller board used in other electrical apparatus besides dynamos? I. C. G.

Yes. Fuller board is the principal insulating material used in transformer manufacture. It is made up in sheets varying in thickness from a few mils to about one-eighth of an inch, although in large transformers it is generally not used in thicknesses of less than one-sixteenth of an inch. It is formed into the proper shapes and assembled with the coils so as to furnish the insulation among the various parts of the winding and between the windings and ground. Being of a fibrous nature it is absorbent, and it is therefore necessary to use such means in operation as will prevent as much as possible the entrance of moisture into the transformer case.

Removing Moisture from Oil

What is the best known method for removing moisture from transformer oil? S. T.

Various methods have been used from time to time for the removal of moisture from transformer oil, such as placing bags of dry lime in the oil, passing hot air through the oil, heating the oil so as to vaporize the moisture and drive it off, or passing it through some form of dehydrator. The latter is the most widely used, and the best form of this class of apparatus is known as the filter press. In this device the oil is pumped through several thicknesses of a specially prepared paper which permits the oil to pass through freely while at the same time retaining every bit of moisture until it becomes saturated. When the saturation point is approached the paper is removed and replaced by fresh dry paper.

Solid Matter in Boiler Feed-Water

What is the source of solid deposits in boilers and how serious is the effect of such deposits on firing efficiency? F. G. N.

Many underground waters dissolve limestone, and when used as feed-water the resulting lime solution is carried into the boiler. Even though the actual percentage of solid material, measured in grains per gallon, is very small, the tremendous quantity of water evaporated during a year by the average steam boiler makes the total solids handled considerable. For example, a unit which evaporates 2000 lb. of water per hour will in a year of twelve-hour days have converted into steam about 8,750,000 lb. of water, which is the equivalent of 730,000 gal. If 1 gal. of this feed-water contains even 25 to 40 grains of mineral matter in solution, the total solids content of the feed supply for the year will be 1,830,000 to 2,920,000 grains. Expressed in more familiar units, the deposit of solids would thus aggregate 2630 lb. to 4190 lb. for the twelve months, were the blow-off unopened and the boiler uncleaned during that period of time.

Such figures give a more concrete idea of the tons of foreign matter which are involved in the slight quantities of dissolved solids in ordinary feed-water than is easily obtained in other ways.

In the past the deleterious effects of scale coatings have been generally overestimated by most textbook writers, for recent observations raise doubt whether the existence of even 0.125 in. of scale will increase to any very great extent the consumption of fuel beneath the boiler. But the principal disadvantage of scale lies in the resulting damage to the boiler parts and even in the explosion hazard it involves. Separating the water from the metal, the scale permits the latter to become overheated, resulting in "burning" or oxidizing, or even softening, of the material, causing bulges or bags under the force exerted by the steam pressure.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Principles of an "Electrostatic Motor."—EUGENE BLOCH.—An abstract of a French Academy paper describing the principles of an electrostatic motor obtained by transforming the classical quadrant electrometer into a motor. If the needle of the electrometer is not suspended, but is simply supported freely on an axis, the electric torque developed will be no longer balanced by an opposite torque, and the needle will be driven into the interior of one of the pairs of quadrants. If at this moment, however, the sign of the charge on either the needle or the quadrants be reversed the needle will continue to revolve, and so on. The author accomplished the latter by providing a commutator for reversing the charge of the needle. The apparatus actually operated, but very irregularly on account of sparking at the commutator. Better results were obtained when, instead of direct current with a commutator, alternating-current excitation was employed. In one of the author's experiments the needle was maintained at 2900 volts by a storage battery, while the quadrants were charged to maximum alternating-current potentials of 5000 volts by a transformer operating from a 42-cycle source of supply. In this experiment a speed of 1260 r.p.m. was obtained. The capacity of such a motor is, however, very small, greatly restricting its possible application.—*L'Industrie Elec.*, Aug. 10, 1913.

Commutator Armature.—ALFRED WINKLER.—A theoretical paper in the first part of which the author discusses the emfs induced in a commutator-type armature. The laws of these emfs, which are usually utilized in plotting vector diagrams for single-phase and polyphase commutator machines, are deduced here as a special case of the general theorem characterizing the action of the commutator. The author then discusses the subject of the ampere-turns of the commutator-type armature and the development of its torque.—*Elek. u. Masch.* (Vienna), Oct. 19, 1913.

Three-Phase Series Commutator Motor.—SCHERBIUS AND C. E. SONNENSCHEIN.—An article, illustrated by diagrams, on the self-excitation phenomena observed in a three-phase series commutator motor with six brushes. When driven as a motor this machine showed distinct self-excitation with unidirectional current. The phenomenon is due to the occurrence of higher harmonic fluxes and occurs only for certain positions of the brushes. Such self-excitation may occur when the machine is operated as a motor or as a generator, returning energy to the system, and may cause continuous losses.—*Elek. Zeit.*, Oct. 23, 1913.

Calculating Alternating-Current Machines.—M. BOUCHEROT.—The conclusion of his long illustrated and mathematical serial on the calculation of alternating-current machines.—*L'Industrie Elec.*, Aug. 25, 1913. The former instalments of this serial appeared in *L'Industrie Elec.*, Nov. 10, 25, and Dec. 25, 1912, and Jan. 10, 25, Feb. 25, March 25, April 10, May 10 and 25 and July 10, 1913.

Lamps and Lighting

Electrodynamics of Arc and Spark Discharges.—ARTHUR SZARVASSI.—A mathematical paper in which the author first gives an outline of the electrodynamics of arc and spark discharges and then derives the deductions that the current curve and the voltage curve of an alternating-current arc have no odd higher harmonics, and that an unstable direct-current arc can be made stable by connecting capacity in parallel with it.—*Elek. u. Masch.* (Vienna), Oct. 12, 1913.

Mercury-Arc Rectifier.—F. PARKMAN COFFIN.—An article illustrated by diagrams giving an outline of the physical phenomena underlying the operation of the mercury-arc rectifier which can be clearly understood only when studied in connection with the general phenomena of gaseous conductivity. The author discusses the spark discharge, the arc, the Geissler discharge, the incandescent rectifier, the mercury-arc lamp and the physical phenomena in the mercury-arc rectifier.—*Gen. Elec. Review*, October, 1913.

Generation, Transmission and Distribution

Rhone Power Transmission to Paris.—There are at present two different projects for utilizing the water-power of the upper Rhone River for electric transmission to Paris. The first contemplates a single dam at Génissiat with a fall of 252 ft. The second calls for two dams at Bellegarde and Malpertius respectively, with falls each 108 ft. in height. The first plant will transmit most of its output directly to Paris. Most of the energy from the second project will be utilized in the districts surrounding the power plant, it being only recently that transmission to Paris has been taken into consideration. The first project is in charge of Messrs. Blondel, Harlé and Mähl, who propose to install 15 units each rated at 17,650 kw, making a total of 265,000 kw available. Energy would be generated at 12,000 volts and distributed at this pressure in the vicinity. For transmission to Paris it was originally intended to raise the potential to 120,000 volts, but now the plan is to use 150,000 volts. Formerly it was proposed to use the Thury direct-current series system, but more recently the three-phase system is receiving the preference. At Paris the pressure would be reduced to 12,000 volts. An extract is given of a recent report made by the head of the Paris lighting system favoring this project. The promoters of the second project propose to erect two power plants, at Bellegarde and Malpertius, the former with twelve 10,000-hp units and the latter with twelve 12,500-hp units. The two plants together would, therefore, have a capacity of 270,000 hp.—*Le Genie Civil*, Vol. 61, 1912, page 213; *Elek. Zeit.*, Oct. 23, 1913.

Electricity in Mining.—JROSLAV HAVLIACK.—A paper on the applications of electricity in the mines of Moravian Ostrau for driving mine ventilators, pumps, air compressors and hoisting machines. In the power houses of the coal mines both gas engines and steam turbines are in use. More recently the steam turbine seems to be favored on account of its lower first cost, lower attendance and lower cost of maintenance. But the matter is one that has not yet been definitely settled.—*Elek. Kraftbetr. u. Bahnen*, Oct. 4, 1913.

Hydroelectric Plants in France.—E. DU LONGUEVAL.—A review of hydroelectric plants erected or projected with special reference to large transmission and distribution systems.—*La Lumière Elec.*, Vol. 22, 1913, page 165; abstracted in *Elek. Zeit.*, Oct. 23, 1913.

Mississippi Power Plant.—M. NORDENSWAN AND C. W. SCHMIDT.—The conclusion of the illustrated description of the Keokuk hydroelectric plant.—*Elek. Zeit.*, Oct. 23, 1913.

Traction

London Traffic in 1912.—A. J. Lawson.—A summary of the statistical figures of the number of passengers carried by the various transportation systems of London during the last year. These are as follows:

	No. of Passengers, 1912.	Increase + or Decrease —
Local railways	436,492,548	+ 3,763
Main-line railways	353,720,501	— 6,171,475
Tramways	796,997,724	— 22,613,551
Omnibuses	533,542,032	+132,913,545
Cabs	65,023,120	— 371,360
Grand total	2,185,775,925	+103,760,922
Estimated population	7,340,079	
Daily rate of increase of passengers	+280,000	

No account is taken of the 5500 private automobiles and 3300 motor cycles registered in the district.—London *Electrician*, Oct. 24, 1913.

Installations, Systems and Appliances

Calculation of Dangerous Rises of Voltage on Transmission Lines.—P. M. Verhoeckx.—A long and highly mathematical paper. The author points out that every theory of dangerous rises of voltage occurring on transmission lines must be based essentially on the electromagnetic-wave theory. The latter in its present form is founded on Heaviside's telegraph equation, which depends in turn on Kirchhoff's mathematical theory presupposing semi-stationary conditions. Such conceptions are, however, really unapplicable in an exact wave theory. For this reason Heaviside's telegraph equation is by no means so generally correct as has been supposed. Its validity is restricted to instances in which plane waves are propagated in a certain direction. This is the case only for straight transmission lines and not at all for wound coils. Even for straight transmission lines Heaviside's equation is exact only if the energy losses in the conductors are infinitely small. To take into account the energy losses in the conductors the author develops a more general telegraph equation which represents the superposition of two non-distorted plane waves traveling with equal speeds in opposite directions and being dampened according to the law of geometric proportion. In certain theories of dangerous rises of voltages in transmission lines the traveling waves are assumed to be of rectangular wave form. While such an assumption may permit of giving a general outline of what happens, it is not exact and cannot be used for numerical calculations.—*Elek. u. Masch.* (Vienna), Oct. 5, 12 and 19, 1913.

Starting Rheostat.—J. Saint-Germain.—A mathematical paper, illustrated by diagrams, on the energy absorption in starting rheostats for direct-current motors and induction motors.—*L'Industrie Elec.*, Aug. 10, 1913.

Wires, Wiring and Conduits

Calculating Electric Networks.—H. Frohman.—A mathematical paper illustrated by numerous diagrams giving some simple rules for the calculation of complicated networks. Numerical examples are added.—*Elek. u. Masch.* (Vienna), Sept. 28, 1913.

Electrophysics and Magnetism

Occluded Gases in Geissler Tubes.—R. W. Lawson.—Sir William Ramsay has described experiments which he considers to prove the transmutation of elements. By passing electric discharges through hydrogen under low pressure, he believed he was able to produce helium. He also throught he could produce synthetical neon from helium and oxygen. Sir J. J. Thomson, however, explained this result as being due to occluded gases. The present author describes experiments which further support the theory of occlusion of gases in the electrodes or in the glass globes of the discharge tubes. His experiments make it improbable that helium is produced by a discharge through hydrogen under low pressure. They also render unlikely the synthesis of neon from helium and oxygen, because helium could be seen after all the neon had been expelled, and oxygen was observed only if the tube had been subjected to the discharge for several hours. The comparative abundance of the observed oxygen seems to exclude any assumption that this gas would be due to the decomposition of neon into helium and oxygen.—*Phys. Zeit.*, Oct. 1, 1913.

Potential Theory.—A. Korn.—A paper recommending an international agreement concerning important conceptions and notations in the theories of potential and of elasticity.—*Elek. u. Masch.* (Vienna), Oct. 12, 1913.

Ferro-Cobalt for Magnets.—Pierre Weiss.—An abstract of a French Academy paper on the magnetic fields obtained with an electromagnet having iron poles provided with special pole-pieces of ferro-cobalt. With a pole diameter of 3 mm, an air-gap of 1 mm and excitation amounting to 100,000 amp-turns, the field produced for iron alone was 52,580 gausses, and with ferro-cobalt 55,170 gausses. The proportion of ferro-cobalt present was 5 per cent.—*L'Industrie Elec.*, Sept. 10, 1913.

Antimony Alloys.—P. Leroux.—An abstract of a French Academy paper on the magnetic properties of lead-antimony and tin-antimony alloys.—*L'Industrie Elec.*, Aug. 25, 1913.

Units, Measurements and Instruments

Graphic Instruments.—Kenelm Edgecumbe.—An illustrated article giving notes on graphic instruments. According to the method employed for tracing the record on the chart, three main groups of graphic instruments are distinguished: First, those in which the pen is attached directly to the measuring instrument, which has sufficient force to render pen friction negligible; second, those in which friction is eliminated altogether by keeping the "pen" out of contact with the paper chart; third, those instruments in which the pen is in contact with the chart in the ordinary way, but instead of being attached directly to the moving system, is controlled through a relay. Various instruments of these kinds are discussed, but chiefly those of the first type. The author gives details of the design of the pen and points out that a source of error which must be carefully guarded against in all moving-pen graphic instruments is the variation of the weight of the pen with the quantity of ink in it, a variation which necessarily affects the indications. The author describes an arrangement in which this source of error is avoided. He then gives details of methods of attaching and insulating the pen arm and describes the pin movement and friction drive of the chart.—London *Elec. Review*, Oct. 24, 1913.

Alternator for Measuring Currents of Telephonic Frequency.—A. Eberling.—An illustrated English translation of A. Franke's recent German article in which a description is given of the latest type of alternator constructed by the author. The machine is used for testing telephone lines and apparatus at such frequencies as occur in practical telephony. Its principle of operation, which remains unchanged, is briefly explained, together with the alterations made and the reasons for them. The author shows that measurements made with the latest type of machine have always given satisfactory results.—London *Electrician*, Oct. 24, 1913.

Measurement of Air Velocity.—H. Gerdien.—An illustrated description of an instrument for measuring air velocities, built by the Siemens & Halske Company. The air the velocity of which is to be measured is passed along two identical and symmetrically arranged sets of resistor wires. Reaching the first set, the air is heated and then passes along the second set, which is therefore less cooled than the first set of resistor wires. The difference of temperature of the two sets of wires is measured by a Wheatstone-bridge arrangement and gives a measure of the speed of the air.—*Elek. u. Masch.* (Vienna), Oct. 19, 1913.

Electro-Kardiograph.—J. RAUTENKRANTZ.—An illustrated description of the latest form of the electro-kardiograph as built by the Siemens & Halske Company for use of physicians in observing and recording the beating of the heart of a patient.—*Elek. u. Masch.* (Vienna), Oct. 5, 1913.

Reading Optophone.—E. E. FOURNIER D'ALBE.—An apparatus is described, depending on selenium for its operation, by which letters on a transparent ground can be recognized by the sounds that result in a telephone. In this way the blind are enabled to read matter suitably prepared by listening through a telephone. The reading optophone consists essentially of a selenium preparation illuminated by a line of light broken up into dots. The light of each dot is intermittent, and each dot has a different frequency. Thus, in one apparatus actually constructed, the frequencies of the eight dots composing a line 8 cm long are in the ratio of the numbers of the diatonic scale, viz., 24, 27, 30, 32, 36, 40, 45 and 48. Large type printed on gelatine or other transparent material, when interposed between the source of light and the selenium, breaks up the line into dots, giving rise to notes differing in tone according to the shape of the letter. With a little practice the letters of the alphabet are easily recognized and "read" by the ear. The arrangement adopted is shown below. The line of light is furnished by a 100-cp tungsten "linolite" lamp whose flux is concentrated by means of a cylindrical water lens upon a revolving perforated brass disk provided with eight circles with the numbers of holes specified above. The disk is spun at about 20 or 30 r.p.m. by an electric motor. As it is not feasible to bring the transparency to

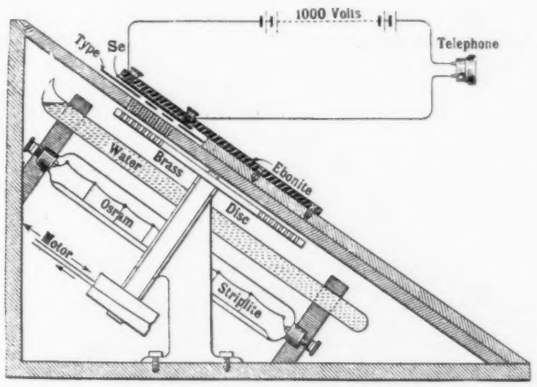


DIAGRAM OF READING OPTOPHONE

be "read" into contact with the brass disk, the luminous dots are transferred to the upper side of a wooden partition by means of a set of glass rods with flat ends embedded in the wood opposite the luminous dots. The flat ends of the rods are flush with the surface of the board, and the transparency can be safely and conveniently slid across them. The selenium bridge *Se* is mounted above the transparency with just sufficient clearance to allow free displacement. The luminous dots transmitted by the type or other transparency impress their frequencies upon the selenium, and the latter gives a musical note corresponding to each dot, even when the beams of light overlap on to the same portion of the selenium. When that occurs with neighboring notes, "beats" are heard, just as when neighboring notes on the piano are struck together.—London *Electrician*, Oct. 24, 1913.

Telegraphy, Telephony and Signals

Insulation Conditions of Austrian Telephone Lines.—R. NOWOTNY.—The insulation requirements of the telegraph and telephone lines along the seacoast of Austria are severe on account of the numerous fogs and occasional deposits of marine salt on the wires. Careful observations were made on a recently installed line from Trieste to Zara, which has a length of 307 km (184 miles), of which 58 km (35 miles) is in submarine cable having a practically constant and very high insulation resistance. For three months the insulation resistances of each of the two conductors of this line were measured with direct current, both from Trieste and from Zara. It was found that very distinct changes of the insulation resistance occurred even with a change of wind. Salt deposits also resulted in impaired insulation. In spite of the considerable fluctuations of the insulation resistance and in spite of the low values reached at times, there was no trouble with telephonic transmission. It is concluded, however, that provision of the line with Pupin coils would have been impracticable under these conditions.—*Elek. u. Masch.* (Vienna), Sept. 28, 1913.

Energy Transmission in Wireless Telegraphy.—M. REICH.—An account of quantitative measurements of the energy transmitted by electric waves. The results confirm the radiation theory of Hertz. In their order of magnitude the currents actually found in the receiver agree well with the theoretical values. Discrepancies noted are due to the fact that transmitter and receiver are not placed on a surface of infinitely good conductivity. Absorption of part of the energy accounts for other differences. The more mountains there are between transmitting and receiving stations the greater will be the absorption. Broad rivers, on the other hand, favor transmission. Weather also has an effect on absorption, which is higher after a heavy rain than in a dry atmosphere. During the night sudden fluctuations of the absorption occur which do not seem to follow any regular laws. On the basis of the figures in the article it is possible to predetermine pretty exactly the current in the receiving antenna for a distance of some hundred kilometers during the hours of the day if the condition of the country between the two stations is known—*Phys. Zeit.*, Oct. 1, 1913.

Book Review

THE D'ESTE STEAM ENGINEERS' MANUAL. With electrical appendix by Charles Penrose. Boston, Mass.: Julian D'Este Company. 356 pages, illustrated. Price, $2.

With only 113 pages devoted to the steam department proper and the remainder of the 356 pages occupied by the voluminous "appendix," strict disciples of James Watt may accuse the compilers of this manual of rather letting the electrical tail wag the canine. But the error has been one of judgment in selecting the title only, for the contents of both sections contain much useful reference information. While the purpose of the book is described as being distinctly practical, an end that is certainly achieved, even the college graduate may consult its pages for freshening his recollections of integral calculus. Steam boilers, steam engines, refrigerating machines, indicators, steam meters and belting are some of the topics handled in terse discussions of essentials, the chapters being interspersed with familiar formulas which the more technical engineer will be glad to find collected in such handy form. Turning over to the preponderating electrical section, the subjects there treated include electrical units, measuring instruments, dynamo-electric machinery, transformers and connections, thermometers and pyrometers, photometric methods, and general principles of design of power-houses and systems. Liberal use has been made of circuit diagrams for showing connections of transformers, meters, switchboards, high-tension oil switches, etc. Manufacturers' catalogs and data have apparently contributed largely to the descriptive and illustrative matter in the book, and there is little presented that has not already been published elsewhere in the electrical press or trade bulletins. But as a compilation, collecting between its covers material drawn from scattered sources, the manual will doubtless fulfil its mission of convenience and service to the reader.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Porcelain Pull-Socket

A porcelain pull-socket recently placed on the market by the Arrow Electric Company, of Hartford, Conn., is illustrated herewith. Instead of being equipped with the ordinary ball chain, the socket is operated by a short piece of strong weatherproof cord to which is fastened the insulated chain. The cord slides easily through the opening in

PORCELAIN PULL-SOCKET

the porcelain shell, making an easy-acting socket, and it is claimed that the cord has been proved by tests to be even more durable than the ball chain on this type of socket.

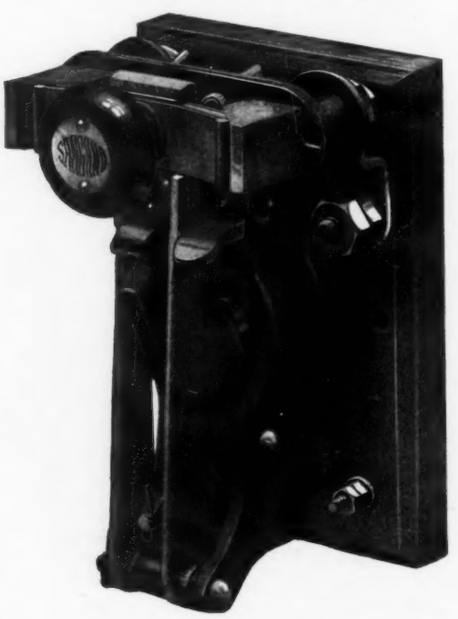
Electric Self-Starters for Motorcycles

Electric starters for motorcycles have made their appearance, as demonstrated at the second national motorcycle, bicycle and accessory show, held at the Coliseum, Chicago, during the week ended Nov. 8. The exhibitor of the motorcycle with this "1914" improvement was the Hendee Manufacturing Company, of Springfield, Mass., the manufacturer of the "Indian" machine. All standard models of this type for 1914 are electrically equipped; that is, for electric self-starting and for electric lighting as well as electric signaling and electric ignition. The self-starting equipment consists of a set of storage batteries suspended in a casing underneath the saddle. By closing a switch the energy from this battery outfit operates a small motor which "cranks" the gasoline engine. When the machine is running at proper speed the motor acts as a dynamo to supply energy to charge the battery. The manufacturer says that the battery connected up in the charging position has a rating of 70 amp-hr. at 6 volts, and connected up in the starting position a rating of 35 amp-hr. at 12 volts. The motor has four poles and is said to develop about 1.5 hp. As a generator it begins to charge the battery at a speed of 12 miles per hour on high gear and 8 miles per hour on low gear. It reaches the maximum at 16 miles per hour on high gear and 12 miles per hour on low gear, the charging being controlled by a regulator attached to the generator. The system is protected by a magnetic cut-out contained in the case with the regulator. It is asserted that the electric starting equipment has been tested for eight months and has operated satisfactorily despite the vibration of the machine. The batteries are sealed and apparently watertight. The motorcycle is also equipped with small tungsten head-lamps and tail-lamps and an electrically operated signal horn. Under ordinary conditions the starting equipment will cause the gasoline engine to begin firing in a cold state in from twelve to fifteen seconds and when the engine is warm it will commence firing in from three to five seconds, it is declared.

Shunt-Trip Circuit-Breaker for Battery-Charging Service

The general use of ampere-hour meters with storage batteries on electric vehicles and in other similar service has created a demand for a durable, rugged and simple type of circuit-breaker for operating in connection with such meters to cut off battery charge when the proper number of ampere-hours has been delivered to the cells. After experimenting with and using various types of circuit-breakers on the market for several years, the Sangamo Electric Company, Springfield, Ill., decided to build one especially designed for this service as shown herewith.

The operating mechanism of this shunt-type circuit-breaker is very simple and rugged. The breaker mechanism is supported on a cast-iron base attached to a suitable sub-base of slate or pressed insulating material. The iron base is hollowed out to receive the operating coil which



CIRCUIT-BREAKER FOR BATTERY-CHARGING SERVICE

is wound with a number of turns of fine wire suitable for the voltage across the charging circuit. The coil is thus iron-clad, giving a very powerful magnetizing effect for a small exciting current. In front of the coil and pivoted to the iron base is an armature or clapper, which when attracted by the coil swings up sharply and strikes the latch lever above. The latch is strong and positive, con-

sisting of a hardened-steel drop forging engaging with a hardened-steel plate riveted to the swinging arm of the circuit-breaker just below the contact brushes.

When the latch lever receives the blow of the armature it drops down, disengaging the arm, which is thrown out by the ejector spring at the bottom of the base. This breaks the main circuit over the two main contact blocks at the top of the circuit-breaker. At the same time auxiliary contact fingers behind the main arm, not shown in the illustration, open the trip-coil circuit, so that there is no possibility of its being burned out nor of the contacts in the ampere-hour meter being burned through opening of the circuit at that point.

The circuit-breaker is easily and positively closed by pressing down the knob attached to the swinging arm, and very severe jarring and vibration is required to unlatch the breaker unless current passes through the trip coil. Current is carried from the contact blocks through heavy copper straps to the main load connections which are at the top of the circuit-breaker. The trip-coil contacts are made on small binding posts at the bottom.

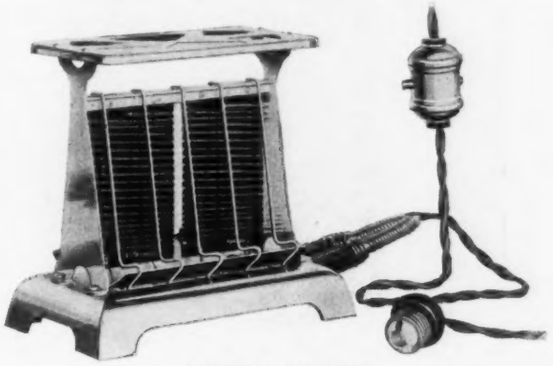
The standard breaker, as shown, is rated at 100 amp for circuits of 30 volts to 125 volts. It will, however, carry continuously currents of 150 amp and can be wound for 6-volt operation. This type of breaker can also be used as an overload or underload or no-voltage release by means of suitable relays. The device is furnished either on an insulated base as shown or with back-connecting studs for switchboard mounting.

Vertical Electric Toaster

The Canadian Westinghouse Company, Hamilton, Ontario, has recently placed on the market a vertical electric toaster. The device shown in the illustration herewith has been designed and finished for use on the dining-room table, all parts being nickel-plated and highly polished. It toasts two pieces of bread at once and has a place on the top where the toast may be kept hot.

This device is very economical in operation. The power used is 550 watts at 110 volts, and two pieces of toast can be made in less than three minutes. The toaster has a record of 6000 hours for toasting, which means that it can make eight pieces of toast every day for almost 100 years.

The heating element is practically indestructible, being made of nichrome, a non-oxidizing and non-rusting alloy. The efficiency of the toaster is increased by a reflector the base of which rests on an insulating asbestos board



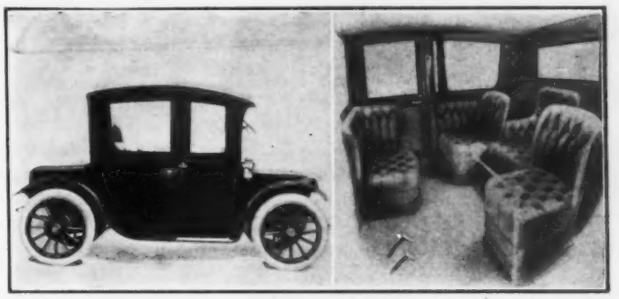
ELECTRIC TOASTER

protecting the base from direct heat radiation or conduction. This construction enables the toaster to be used on an uncovered table without damaging the finish of the wood.

The toaster weighs slightly less than 2.5 lb. and is 7 in. in height. It is furnished complete with a silk cord and an attachment plug.

1914 Model Electric Passenger Vehicles

The Waverly 1914 model, four-chair brougham, illustrated herewith, has an unusual seating arrangement. Each passenger is provided with a separate Pullman chair, three of these chairs taking the place of the usual rear seat running the full width of the car. By placing the center chair slightly back of the other two a 9-in. width



FOUR-CHAIR BROUGHAM

of seating area is gained, giving 61 in. instead of 52 in. The fourth passenger is accommodated in a "cozy-corner" seat at the right. With such an arrangement the driver is placed with the other occupants and not in front of them.

Other 1914 models of the same company are the "front-drive-four," a new car with "stream-line" body design and a four-passenger seating arrangement, all seats facing forward; the "rear-drive-four"; the "front-and-rear-drive" brougham with dual drive, which permits the operator to drive from either the front or the rear seat, and the five-passenger limousine. All seats of the five-passenger limousine face forward. Three passengers are carried on the rear seat. The driver has an individual seat and also a separate door for entering and leaving the car. The fifth passenger occupies the right-hand front seat.

Recent Developments in Lead Vehicle Batteries

In enumerating developments in batteries for the operation of electric vehicles at the recent Chicago convention of the Electric Vehicle Association, Mr. Bruce Ford, of the Electric Storage Battery Company, Philadelphia, Pa., said that in the past the life of the flat-plate type of cell has always been figured in terms of the life of the positive plate. In "iron-clad-exide" batteries, however, the positive plates have been designed to be one of the strongest elements in the combination. The problem of maintaining separation between the positive and negative plates has been the only real difficulty encountered. It has been found rather desirable to increase the free clearance space between the vertical tubes of the positive plates and the wood separators. This has been accomplished by a new design of negative grid with sufficient reduction in thickness to allow the desired addition to the separator and ribs on the positive plate. In the latest type of cell the frame of the positive plate is undercut and the negative plate instead of the positive is sheaved, overcoming difficulties incident to moss growths which formerly gave trouble. The exposed edges of the outside tubing are also reinforced by being left unslotted in the latest type of positive plate. To test the ability of various cells to withstand the abuse of overcharging, three sets of batteries of different types were connected in series and charged continuously at 10 amp twenty-four hours each day. While the other type of cells soon disintegrated, the "iron-clad" plates are still intact after sixteen months. The depth of sediment in this battery is at present about 0.125 in. In closing, the author recommended the boosting charge as an efficient means of increasing the daily capacity of a battery and gave methods for figuring boosting rates.

GRIPPER AND SIDE GUIDE

Messrs. Rabenalt, Conant, L. Demmert, Baker and others took part in the discussion. Mr. Demmert believed that better results can be obtained from a flat plate than from a thin one. Mr. Baker spoke of a 2-ton truck which was equipped with thin-plate batteries and the charge boosted at a high rate during the noon hour with good results. Mr. Ford said that even if used as a counter-cell the "iron-clad" battery seems to hold up under trying conditions.

Electric Rotary Floor Scrubber

An improved type of electrically operated floor scrubber recently developed by the Finola Manufacturing Company, of Hannibal, Mo., is shown in the accompanying illustration. Small and medium-sized floors can be scrubbed at a lower rate per square foot with this machine, it is declared, than by the old manual method. The scrubber is driven by a 0.25-hp motor which is geared to the rotary brushes and to a reciprocating pump. Soap powder is contained in the small box on the front of the machine. From the larger tank behind the soap receptacle water is sprayed onto the floor in front of the rotary brush, mixing with the powder which is automatically sifted as the machine moves. Levers on the handle control the rate at which water and soap powder are delivered onto the floor, and also operate a squeegee which dries the scrubbed surface. The reciprocating pump previously mentioned sucks up the dirty water collected by the squeegee and transmits it to the removable tank at the rear of the outfit.

IMPROVED ELECTRIC ROTARY FLOOR SCRUBBER

Electricity is supplied to the motor through flexible cord which is wound on a retrieving reel. One end of this cable is connected to a plug receptacle and the other to slip-rings on the reel which lead to the motor. As the machine is pushed along the floor the flexible cable is unwound, being kept taut by a spring inside the reel. A switch on the handle controls the operation of the motor.

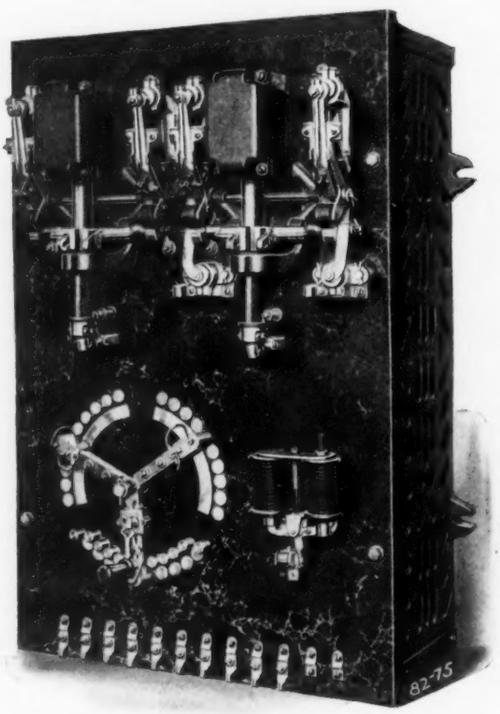
Automatic Alternating-Current Controllers

An automatic controller for single-phase, two-phase or three-phase induction motors used in driving printing presses and other machinery requiring adjustable speed has been put on the market by the Monitor Controller Company, Baltimore, Md. Starting, stopping, reversing and jogging of the press can be done automatically, control being obtained from a simple station on the press either by a push-button or by a safety lever.

PUSH-BUTTON BLOCK

The principal feature of this new controller is the automatic insertion of a proper resistance in each phase of the motor, this resistance being the same regardless of the position of the regulating handle. After the motor has attained the proper speed the starting resistance is automatically cut out, and the regulating resistance, which has been previously determined by setting the handle, is automatically thrown in, bringing the motor promptly to the speed desired.

In case the supply of energy to the motor has been shut off suddenly and the motor therefore stops, the entire system is automatically cut out, and on the return of current the motor will not start until the operator has again touched the starting button or lever, when the starting cycle is repeated. No-voltage release circuit-breakers are therefore unnecessary.



AUTOMATIC CONTROLLER FOR INDUCTION MOTORS

The Monitor controller is also useful in "inching" or moving the bed any fractional part of its stroke, this being an operation that must often be done by laboriously moving the flywheel by hand.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

St. Gothard Railway in Switzerland to Be Electrified.—Press reports during the past week state that the Swiss government has provided for the expenditure of $7,600,000 for the electrification of the St. Gothard Railway and that this is the first step toward electrification of the entire national railway system in Switzerland.

Large Insulator Order Placed.—The Los Angeles plant of the California Glass Insulator Company is to be increased in capacity by the addition of $40,000 worth of new machinery which is being installed to help take care of an order for 15,000,000 insulators placed with this concern by the Pacific States Electric Company. The contract involves an expenditure of $1,500,000 by the utility company, and it is a particularly large one for this class of apparatus.

Activity in Byllesby Properties.—The net gain in connected new business during the last week in October on all the electric properties operated by H. M. Byllesby & Company was 614 customers with 746 kw of lighting and 667 hp in motors. New contracts not yet connected amounted in the same period to 1162 customers with 682 kw of lighting and 446 hp in motors. On Oct. 24 the Minneapolis General Electric Company broke all its previous records by generating 347,930 kw-hr. of energy.

Electric Equipment for Canadian Paper Mills.—Two large orders for electric-drive equipment have recently been placed with the Canadian General Electric Company by paper-mill interests. The Donnaconna (Que.) Paper Company order embraces a number of motors of various ratings up to 150 hp and totaling 1330 hp. The Abitibi Pulp & Paper Company has ordered motors ranging from 400 hp downward and aggregating 2165 hp for installation in its new mills at Iroquois Falls, Ont.

Booming Electrical Heating Devices.—The American Electrical Heater Company, Detroit, Mich., is offering to dealers in electrical appliances the use of slides for moving-picture theater advertising of its heating devices as Christmas gifts. The company has also prepared some special Christmas advertisements on its various devices, electrotypes of which are offered to dealers for use in their local papers. Both of these advertising offers promise practical assistance to the dealer in educating his local clientele in the giving of electrical gifts for the home.

Wire Manufacturers Not Thinking of Selling Out.—Some rumors have been around lately concerning a proposed purchased by the Westinghouse Electric & Manufacturing Company of the Safety Insulated Wire & Cable Company, of New York. Interviewed in regard to this matter during the past week, C. E. Graham, vice-president of the wire concern, stated that the rumor was absolutely without foundation and that no offer preliminary to such a change in ownership had been made by either company or was anticipated, so far as he knew.

Electrically Heated Water Sterilizers Sold.—The Forbes Company, of Philadelphia, Pa., has recently sold through its New York agents, Westerberg & Williams, of 233 Broadway, three of its electrically heated water sterilizers to public utility companies in that city. The New York Edison Company has had one of these sterilizers in operation for some time at its Forty-second Street office and has ordered two more for installation at its generating stations. The United Light & Power Company, also of New York, has purchased one of these sterilizers.

Jobbers' Sales in Pittsburgh District Remain Steady.—Two prominent electrical jobbers supplying railroads and steel mills in the Pittsburgh district stated in a recent interview with a representative of the *Electrical World* that sales were increasing slightly from month to month throughout the busy season. In this territory the great railroad systems are regarded as the most reliable thermometers of trade conditions. The purchases of these roads as indicated in the general trend of the jobbers' business have been on a par with those of previous average years. The representatives of the steel industry are also buying electrical supplies to complete preparations for the dark days of the coming winter.

Association of Purchasing Agents Formed.—During the past month there was formed in New York City, with headquarters in the same place, an organization known as the National Association of Purchasing Agents, the main objects of which are to further mutual acquaintance among purchasing agents in all lines, to standardize purchasing methods and routine, to investigate and certify new appliances and materials, to arrange improved publicity methods, and to standardize specifications. Sub-associations in different sections of the country will be formed to care for local interests. The temporary chairman of the association is H. T. Leeming, of Thomas A. Edison, Inc., and the temporary secretary and treasurer is E. B. Hendricks, whose headquarters are at the Hotel McAlpin, New York City.

Electrically Driven Pumps Ordered for Panama.—The Isthmian Canal Commission has just awarded the contract to the Blackall-Baldwin Company, of 39 Cortlandt Street, New York, for furnishing extensive pumping equipment for the Panama water supply pumping stations at Ancon and Miraflores, Canal Zone. These centrifugal pumps, fourteen in number and ranging in capacity from 250 gal. to 5,000 gal. per minute, will be of the horizontal volute type of one, two and three stages and will operate under heads of from 70 ft. to 355 ft. They will be built by the Kingsford Foundry & Machine Works. The motors for driving these pumps are to be directly connected to them and will be three-phase squirrel-cage induction motors, operating on 25 cycles and voltages of 220 and 2200. The range in capacity of the motors is from 7½ hp to 345 hp, and they are to be supplied by the General Electric Company.

Westinghouse Machine Company to Have Increased Manufacturing Facilities.—At a recent meeting of the executive committee of the Westinghouse Machine Company an appropriation of $125,000 was made to provide additional manufacturing facilities. The additional equipment is required to take care of the rapidly increasing business which the Westinghouse Machine Company has been enjoying recently, owing in a large measure to the new lines of products developed. Among these particular mention may be made of the impulse turbine, the reduction gear, the automobile rotary valve motor and the air-spring for automobile trucks. The first mentioned has found large use in central stations and industrial plants and the second, in addition to a wide demand for marine installations, is finding large application in direct-current generator design. The company contemplates devoting a portion of the above appropriation to securing additional machine tools, designed to use high-speed tool steel.

Interlocking Directorate Plan Opposed.—In connection with the active debate which has been aroused by the proposed extensive changes in the country's banking system there has been given an added impulse to the agitation against the interlocking directorate system which is so prominently and generally associated with corporate control. Through the workings of this system it is not unusual for the same individual or group to control in a given locality, both the banks and the companies using their service, a condition which often leads to unhealthy finances. Also by the same system it is often possible for a minority

interest to control extensive operations in an industry, or in several allied industries, for its own benefit. For some years there have been spasmodic attacks on this system in Congress, and there is a feeling in some quarters that the present discussion of the currency question will precipitate a legislative attack upon the interlocking directorate system during the coming winter.

Fuse Manufacturer Arranges to Supply New Line Pending Litigation.—On Oct. 28 the United States District Court for the Eastern District of Pennsylvania granted a temporary injunction to the Johns Pratt Company, of Hartford, Conn., restraining the Economy Fuse & Manufacturing Company from the further sale of inclosed-type fuses of the kind said to infringe the patents of the first-mentioned concern. Following the decision the latter company has begun work on a new form of inclosed fuse which, while using the same style of terminals, casings and links as those in the former type, is said by that company to fall without the scope of the injunction. It is claimed that the tests on these new fuses show them to be fully as satisfactory as the older type, and the company expects to be able shortly to supply all orders affected by the injunction.

Transmission Towers Constructed.—The Blaw Steel Construction Company, of Pittsburgh, Pa., has lately received contracts to build a number of transmission towers for electric energy supply companies. The Pennsylvania Water & Power Company, of Baltimore, Md., has ordered about 430 standard towers and some special crossing towers for its new 110,000-volt transmission line between Holtwood, Pa., and Baltimore, Md. A contract for 100 standard towers and a number of special towers for a double-circuit 55,000-volt line has been awarded by the Penn Central Light & Power Company, of Altoona, Pa. Other projects for which orders have recently been placed for similar equipment are the Lake Shore Electric Viaduct, in Elyria, Ohio, and the tower line at Riverside, N. J., in which R. D. Coombs & Company, of New York, are interested.

Statement of the Copper Producers' Association for October

While the stocks of copper on hand on Oct. 31 show a slight increase over September figures, they are still lower than ever before in the history of the association, with the exception of that month. As shown in the following summary, the export deliveries fell off in October.

	October, pounds		September, pounds	
Stocks on hand in the United States on first of month		29,793,094		38,314,037
Production		139,070,481		131,401,229
		168,863,575		169,715,266
Domestic deliveries	68,173,720		66,836,897	
Foreign deliveries	68,123,473		73,085,275	
		136,297,193		139,922,172
Stocks on hand at end of month		32,566,382		29,793,094

NEW YORK METAL MARKET PRICES

	Nov. 3 Bid.	Nov. 3 Asked.	Nov. 11 Bid.	Nov. 11 Asked.
Copper:				
Standard, spot*	.....	.....	.....	.....
	Selling Prices £ s d		Selling Prices £ s d	
London, standard, spot*	71 10 0		68 7 6	
Prime Lake	16.87½	.....	16.00	to 16.25
Electrolytic	16.37½	.....	15.75	.....
Casting	16.00	.....	15.50	.....
Copper wire base	17.50	to 17.75	17.00	.....
Lead	4.35		4.35	
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet zinc, f.o.b. smelter	7.50		7.50	
Spelter, spot	5.37½	.....	5.30	to 5.40
Tin, spot	39.70	to 40.00	39.15	to 39.35
Aluminum:				
Prompt delivery	19.75	.....	19.50	to 19.75
Future	19.50	to 19.62½	19.25	to 19.50

***OLD METALS**

Heavy copper and wire	15.00	14.50
Brass, heavy	9.75	9.50
Brass, light	8.50	8.25
Lead, heavy	4.20	4.20
Zinc, scrap	4.37½	4.37½

***COPPER EXPORTS**

Total tons to Nov. 11 10,547

*From daily transactions on the New York Metal Exchange.

Corporate and Financial

Organization Changes in Kings County Electric Light & Power Company.—At a meeting of the directors of the Kings County Electric Light & Power Company on Nov. 5 N. F. Brady was elected president, to succeed the late A. N. Brady, and J. C. Brady was elected vice-president and director. The directors also declared the regular quarterly dividend of 2 per cent on the outstanding capital stock, payable on Dec. 1.

St. Louis Suburban Utilities.—The new officers of the Electric Company of Missouri doing business in the suburban area surrounding St. Louis are: President, J. D. Mortimer; vice-president, C. S. Ruffner and A. C. Einstein; secretary, J. F. Fogarty; treasurer, Robert Sealy; assistant secretary, S. H. Wallace; assistant treasurer, P. F. Schroers. The St. Louis County Gas Company has practically the same officers. The two companies work in harmony with the Union Electric Light & Power Company, of St. Louis.

United Light & Railways Company Adds to Transfer Agencies.—Changes have been made recently by the United Light and Railways Company in its arrangements for the transferring of stock certificates. Since Nov. 1 these have been transferred in New York by the Guarantee Trust Company and registered by the Bankers' Trust Company, in Chicago they have been transferred by the Continental and Commercial Trust and Savings Bank and registered by the Illinois Trust and Savings Bank, and in Grand Rapids the certificates have been transferred by the company itself and registered by the Michigan Trust Company. It is claimed that the large distribution of the company's stock has made necessary the three transfer agencies.

Bangor Power Company's Dam Completed.—The new dam of the Bangor Power Company at Veazie, Maine, was recently completed, according to an announcement made by E. W. Clark & Company, of Philadelphia, Pa., who control the Bangor Railway & Electric Company, of which it is a subsidiary. This new dam is located on the Penobscot River about 3 miles above Bangor, and its construction adds 1000 hp to the company's generating capacity, giving it a total capacity of 18,750 hp. The old Veazie dam, built of timber about sixty years ago, was one of the earliest hydroelectric developments in the United States. The Bangor Railway & Electric Company has recently secured the extension of several of its franchises for street-railway operation.

Washington Utility Plans Expansion.—The Skagit Power Company, which is under the management of the Stone & Webster Management Association, of Boston, Mass., has received a permit to develop two large hydroelectric power sites on the Skagit and Cascade Rivers in the western part of the State of Washington. These sites, it is expected, can be developed on a large scale economically, so that it will be possible to furnish power from them at very low rates. The company, which has its headquarters in Seattle, has established an industrial department with W. E. Herring in charge and is endeavoring to get manufacturing plants located in the vicinity. In its development of the project the company plans to keep ahead of the power requirements so that reserve power will always be available.

Illinois Traction Company Absorbs Western Railways & Light Company.—Announcement is made that the Illinois Traction Company, of Champaign and Peoria, Ill., is about to absorb the Western Railways & Light Company. The proposed merger is to be accomplished through the purchase of the common stock of the Western company by issuing one share of Illinois Traction common stock in exchange for two shares of the Western company's common stock. Both companies are McKinley properties and have practically identical management and principal ownership. Mr. W. B. McKinley, of Champaign, Ill., is president of both companies, and Mr. H. E. Chubbuck, of Peoria, Ill., is vice-president executive in each case. The plan has been in contemplation for some time and is being put into effect to bring about the economies which will result. The Western Railways & Light Company controls the Galesburg (Ill.) Railway & Light Company, Illinois Valley Railway Company, Chicago, Ottawa & Peoria Railway Company, Quincy (Ill.) Railway Company, Citizens' Lighting Company of La

Salle and Peru, Ill., Northern Illinois Light & Traction Company, Cairo (Ill.) Railway & Light System, Consolidated Water & Light Company, Marseilles, Ill., Mound City (Ill.) Light & Water Company, Abington (Ill.) Light & Power Company, Wichita (Kan.) Railroad & Light Company, Atchison (Kan.) Railway, Light & Power Company and Jefferson City (Mo.) Light, Heat & Power Company. The authorized capital stock of the Illinois Traction Company is $20,000,000, half common and half 6 per cent preferred.

New Assessment on Stock of the Philadelphia Electric Company.—The directors of the Philadelphia Electric Company have placed an assessment of $5 per share on the stock of that company payable Dec. 1. This new assessment makes the stock $22.50 paid. An extra stock dividend of $1.50 per share has also been declared by the directors payable on the same date as the assessment. In connection with this assessment on the stock of the company a statement has been made concerning its plans for expansion in the near future, for which the assessment will provide. An addition of 37,000 hp has lately been made to the company's generating capacity and a similar increase is planned for next year. In addition to a large prospective load, the street railway system in Philadelphia is making constantly larger demands for electric power for operating its lines.

Initial Installation at Big Creek, Cal.—Through the office of C. E. Graham, vice-president and director of the Pacific Light & Power Corporation, 25 Broad Street, New York, it is learned that during the past week the first electric energy supply from that company's hydroelectric development at Big Creek, Cal., was furnished to the city of Los Angeles, Cal. The present generating capacity is about 60,000 hp, and there is a transmission line 165 miles in length between the generating station and Los Angeles, where the principal demand is at present centered. The energy is used for the street railways in the above city largely, also for municipal and general lighting service. An ultimate capacity of 350,000 hp is claimed for the Big Creek development, and this will be used as fast as the demand for electrical energy in that section requires. The Stone & Webster Construction Company, of Boston, Mass., is the engineer and contractor on this work.

Southern California Edison Financing.—It is reported that the Southern California Edison Company is planning to offer shortly to its stockholders, at 85, two-thirds of the $3,000,000 common stock recently authorized by the California Railroad Commission. This offering is preliminary to the sale of the stock to a syndicate which has been formed to underwrite the issue. Previous to the issue of this new common stock the company had a capitalization of $8,400,000 common and $4,000,000 of 6 per cent preferred stock, and $10,717,000 of the company's bonds are outstanding. The proceeds of the new issue are to be used for the payment of $1,010,000 of floating debt and the rest for the retiring of debentures and the part payment of the costs of improvements on the company properties. The earnings of the company are reported to be showing large increases, and it is thought possible that the dividend on the common stock may be increased from 5 per cent to 6 per cent during the first quarter of 1914.

Toledo Traction, Light & Power Company Matters.—The Toledo Traction, Light & Power Company's preferred stock becomes cumulative at 6 per cent on Jan. 1, 1914, and its net earnings are expected to increase largely in the near future, warranting an initial dividend on this stock on April 1. This company owns all of the bonds and other securities of the Toledo Railways & Light Company and its subsidiaries, excepting $4,191,000 underlying bonds and a small amount of stock not deposited at the time of the reorganization last January. The gross earnings of the latter company for the fiscal year ended Aug. 31 were $4,194,987, and its net earnings were $1,347,768. A large amount of money is being spent at present on rehabilitation of the company's properties, and when this work is completed, as it is expected to be in the near future, an increase in the net earnings should be shown. In its lighting and power departments the company is making a rapid gain in business, and a considerable outlay has been necessary for additions to its generating capacity and extension of its transmission and distribution facilities.

Business Notes

E. W. Clark & Company, investment bankers, of Philadelphia, Pa., have recently established a department of their business for the dissemination of news matter on the various public utility properties under their control or management. These utilities are scattered from Maine to Oregon and from Tennessee to Michigan, and their combined annual gross income is said to be in the neighborhood of $31,000,000.

The Automatic Cable Clamp Company, of Donora, Pa., announces the following firms as its representatives in various sections of the country: The Pettingell-Andrews Company, Boston, Mass., for the New England States; the Bressan-Young Company, 27 Thames Street, New York, for eastern Pennsylvania, New York, and the Southeastern States; the Union Electric Company, Pittsburgh, Pa., for the Pittsburgh district and West Virginia, and the I. A. Bennett Company, 565 West Van Buren Street, Chicago, for the Western and Southwestern States.

The Roffy-Grace Corporation, of 1926 Broadway, New York, is preparing to market the products of the Ak-ray Corporation, of the same address. At the present time the latter concern is largely occupied in the development of a new electric automobile headlight which is claimed to possess marked advantages over the usual type of lamp. The officers of the two companies are identical. S. P. Grace, president, has been until recently superintendent and chief engineer for the Bell Telephone Company in Pittsburgh, Pa., and J. T. Roffy, vice-president and secretary of the companies, has been connected with the Westinghouse enterprises for a number of years and has perfected a number of special illumination devices.

New Industrial Companies

The Federal Hardware & Electric Company, of Boston, Mass., has been incorporated with a capital stock of $10,000 by John F. Chevalier and Stephen S. Grady.

The Carl Electric Vehicle Company, of Toledo, Ohio, has been incorporated with a capital stock of $300,000 by L. M. Henders, M. G. McAleenan and B. E. Roberts.

The Northwestern Pacific Callophone Company, of Seattle, Wash., has been incorporated with a capital stock of $100,000 by M. M. Block, J. H. Claridan and others.

The Wright-Howard Electric Company, of Los Angeles, Cal., has been incorporated with a capital stock of $10,000. The directors are G. C. Wright, W. F. Wright and W. D. Smith.

The Buffalo Electric Vehicle Company of the Pacific Coast, of Los Angeles, Cal., has been incorporated with a capital stock of $500,000 by J. R. Avery, A. D. Avery and N. A. Boile.

The Kemoo Electric Manufacturing Company, of Cleveland, Ohio, has been granted a charter with a capital stock of $100,000. The incorporators are Wallace I. Knight, C. G. Roades and Herbert Matthews.

The General Electric Utilities Company has filed articles of incorporation with a capital stock of $100,000 under the laws of the State of Delaware. The incorporators are H. Roys, J. W. Heaney and R. I. Guthman, of New York, N. Y.

The McIntosh Richards Company, of Grand Rapids, Mich., has been incorporated with a capital stock of $10,000 to manufacture gas, electric and combination fixtures. The incorporators are William L. G. McIntosh, Fred W. Richards and William McIntosh.

The Wallace & Tiernan Company, of New York, N. Y., has been incorporated by Joseph Maucuse, C. A. Simpson and M. A. Lynch, 165 Broadway, New York, N. Y. The company is capitalized at $25,000 and proposes to manufacture sanitary and electrical equipment.

The Alliance Electric Company, of Hornell, N. Y., has been incorporated with a capital stock of $10,000 by A. W. Dalton, Charles F. Kistinger and Stephen C. Reville, 705 West 144th Street, New York, N. Y. The company proposes to do an electrical contracting business.

Trade Publications

Trolley Omnibus.—A small booklet recently sent out by the Field Omnibus Company, of New York, gives some interesting information on its double trolley bus for passenger service.

Conduits and Fittings.—The "Austin Post" is the title of a trade pamphlet issued monthly by M. B. Austin & Company, of Chicago, Ill., to keep the world informed on its various products.

Ball Bearings.—The single annular type of F. & S. ball bearings is shown in a pamphlet lately issued by the J. S. Bretz Company, of 250 West Fifty-fourth Street, New York, sole importer of this German product.

Pyrometers.—Catalog No. 1400 of the Bristol Company, Waterbury, Conn., refers to the Bristol electric pyrometer for measuring temperatures up to 2000 deg. Fahr. A list comprising seven pages gives the names of a partial number of users of this instrument.

Busbar Supports.—The Delta-Star Electric Company, Chicago, has issued a bulletin devoted to high-tension busbar and wiring supports. With the standard units listed, over 7000 combinations are possible, thus greatly simplifying high-tension station and switchboard wiring.

Aluminum for Automobile Parts.—The British Aluminum Company, Ltd., of 109 Queen Victoria Street, London, England, has put out a catalog showing the advantages of aluminum for automobile fittings and illustrating the standard shapes in which it is obtainable for such service.

Electric Vehicles.—Issue No. 17 of *Small Motors*, published monthly by the Westinghouse Electric & Manufacturing Company, is devoted to the subject of electric vehicles. Vehicle equipments are fully described. Characteristic curves of vehicle motors are given, as well as halftone views and cross-sections of the different motors.

Terminals.—The Standard Underground Cable Company, Pittsburgh, Pa., has issued Bulletin No. 710-I, devoted to indoor cable terminals. The terminals described are said to represent an improvement on earlier forms of potheads, end bells, etc. They are designed for indoor use. The bulletin shows a large variety of these terminals to cover practically every need of the cable user.

Soot Cleaner.—A forty-eight-page pamphlet bearing the title "Economical Steam Production" has recently been issued by G. L. Simonds & Company, Chicago, Ill. It is an exhaustive treatise on the subject of soot in relation to boiler efficiency and contains useful engineering data on soot cleaning as applied to all types of water-tube and fire-tube boilers, referring especially to the Vulcan system.

Diesel Engines.—The Consolidated Diesel Engine Manufacturers, Ltd., has recently put out an attractive pamphlet describing the Diesel engine pumping station at Gladstone Dock, Liverpool, England, which is said to be the largest installation of this class of internal-combustion engines yet completed. W. R. Haynie, American representative of the company, with offices at 30 Church Street, New York, can supply these pamphlets to interested parties.

Globes and Reflectors.—The Lighting Studios Company, Madison Avenue, corner Thirty-first Street, New York, has recently issued an attractive catalog under the title "A Handbook of Our Creations in Lighting Glassware and Specialties." It is printed in loose-leaf form, in a binder arranged to permit of future additions, and contains illustrations of artistic shades, reflectors, hemispheres, ball globes, dishes, urns and some recent installations.

Electric Calendar.—Miss Grace T. Hadley, 350 North Clark Street, Chicago, has designed an attractive electric calendar for 1914. This is a wall calendar, intended to portray the "home electrical." It consists of a cardboard sheet for every month, each page also containing recipes for electrical cooking, verses having to do with the use of electricity, or something of that sort. There is also an appropriate illustration on each sheet. The title page or cover is handsomely printed in black and gold on a tinted background. The calendar is designed particularly to interest women and may serve as a novelty or premium to be sent out by those interested in extending the sale of electricity or electrical appliances.

Personal Mention

Mr. A. V. Bemis has succeeded Mr. N. A. Lee as superintendent of the municipal electric light and water plant at Hawley, Minn.

Mr. J. E. Buss has recently been appointed superintendent of the municipal electric light and water works at Hallettsville, Tex.

Dr. Karl Georg Frank, American representative for Siemens & Halske and associated companies, sails from New York on Nov. 15 to spend about two weeks in London and Berlin.

Mr. F. McSweeney, of the Citizens' Gas & Electric Company, of Waterloo, Ia., has been appointed superintendent of the company's Cedar Falls branch, as successor to Mr. J. P. Jones.

Mr. E. L. Locke, for several years superintendent of the Arlington (Mass.) Gas Light Company, has resigned to accept the superintendency of the Light, Heat & Power Corporation of Boston.

Mr. A. B. Coryell, of Lafayette, Ind., has been appointed superintendent of the electrical and tramway department of the Moncton (N. B.) Tramways, Electricity & Gas Company, Ltd., vice Mr. H. N. Price, resigned.

Mr. J. P. Jones, superintendent of the Citizens' Gas & Electric Company, Cedar Falls, Ia., has been appointed assistant general superintendent at Waterloo, his place at Cedar Falls being taken by Mr. F. McSweeney.

Mr. B. J. Jones, general manager of the Ohio Electric Railway Company, Cincinnati, Ohio, has been appointed general manager of the Tri-State Railway & Electric Company, East Liverpool, Ohio, as successor to Mr. W. R. W. Griffin.

Mr. George F. Mitchell, who has had charge of the commercial division of the Red Wing (Minn.) Gas Light & Power Company, has resigned in order to accept a position in the commercial department of the Jackson (Miss.) Light & Traction Company.

Mr. L. K. Bingaman, for many years connected with the old Edison Electric Illuminating Company, of Sunbury, has been appointed business manager of the Northumberland County Gas & Electric Company, of Sunbury, as successor to Mr. S. G. Reque.

Mr. S. G. Reque, general superintendent of the Northumberland County Gas & Electric Company, of Sunbury, Pa., has been appointed engineer of generation and transmission of that company and to a like position with the Columbia & Montour Electric Railway Company.

Mr. Heinrich J. Freyn, formerly consulting engineer of the gas engine department of the Allis-Chalmers Manufacturing Company of Milwaukee, has recently joined the H. Koppers Company, of Chicago, designer and builder of by-product coke and gas-oven plants, in the capacity of third vice-president.

Prof. C. Francis Harding, head of the School of Electrical Engineering, Purdue University, Lafayette, Ind., is acting as consulting electrical engineer for the recently established Public Service Commission of Indiana and in this capacity has recently completed the appraisal of two of the largest electrical public utility companies in the State, under the direction of Mr. H. O. Garman, formerly of Purdue University, who is chief engineer for the commission.

Mr. A. N. Dutton, who has been vice-president of the West Virginia Traction & Electric Company and manager of the City Railway, Wheeling, W. Va., has been elected president of the City Railway and the City & Suburban Gas Company, Wheeling. He succeeds Mr. H. R. Warfield as president of the City Railway and succeeds Mr. J. B. Taylor with the City & Suburban Gas Company, Mr. Taylor becoming vice-president of the City & Suburban Gas Company.

Mr. V. W. Bergenthal, assistant sales manager of the Wagner Electric Manufacturing Company, has been appointed purchasing agent of the company. Mr. Bergenthal is a graduate of the University of Wisconsin. After graduation he joined the engineering staff of the Stanley Electric

Manufacturing Company at Pittsfield, Mass., and later was sales engineer and assistant manager of the Western office of that company at Chicago, Ill. Since 1904 Mr. Bergenthal has occupied the position of assistant sales manager of the Wagner company.

Mr. S. C. Pohe, general superintendent of the Columbia Power, Light & Railways Company, of Bloomsburg, Pa., has been made general manager of the company, which controls the Columbia & Montour Electric Railway Company, the Danville & Bloomsburg Street Railway Company, the Standard Gas Company of Danville, the Standard Electric Company of Danville, the Irondale Electric Light, Heat & Power Company, the United Gas & Electric Company, the Berwick Electric Light Company and the Northumberland County Gas & Electric Company of Sunbury. Mr. Pohe is well known in the electric-lighting circles in Pennsylvania and is secretary of the Pennsylvania Electric Association.

Sir Joseph Wilson Swan, F.R.S., inventor of the incandescent lamp bearing his name, celebrated his eighty-fifth birthday Oct. 31. He is still engaged in active scientific work. In addition to his well-known researches leading up to his electric-lighting inventions, Sir Joseph devised the autotype carbon process for making permanent photographs, discovered the means of making rapid dry plates which revolutionized the art of photography, and made many improvements in photo-mechanical printing and in electro-metallurgical deposition. The distinguished inventor has many honorary degrees and is a past-president of both the British Institution of Electrical Engineers and the Faraday Society.

Mr. C. Nesbitt Duffy has resigned as vice-president and controller of the Milwaukee (Wis.) Electric Railway & Light Company to become vice-president and general manager of the Manila (P. I.) Electric Railroad & Light Company. Mr. Duffy expects to leave Milwaukee about Nov. 15 for St. Louis and will go from there to San Francisco, whence he will sail on the *Manchuria* on Nov. 27, arriving in Manila on Christmas day. Mr. Duffy entered the employ of the Milwaukee Electric Railway & Light Company as controller on Oct. 1, 1906, succeeding Mr. A. C. Mackay. In May, 1912, he was also elected a vice-president of the company. The call to Manila comes as a recognition of Mr. Duffy's wide general knowledge of the industry and his experience and ability as an administrative official. In his new work he will find large opportunities for the use of the abilities which he has developed and for the broadening of those principles of enlightened public policy of which he has always been an exponent.

C. NESBITT DUFFY

Obituary

Edward Fleet Morse, inventor of the Morse silent chain, died Nov. 11 at Ithaca, N. Y., aged fifty-six years. In addition to the Morse chain, Mr. Morse invented the Morse thermo-gage, an instrument for measuring the temperature of steam.

Joseph Ernest Hodgson, general manager of the Fulton County Gas & Electric Company, Gloversville, N. Y., died in that city on Oct. 26. Mr. Hodgson was born in Brooklyn, N. Y., May 27, 1873, and was a graduate of the Polytechnic Institute of Brooklyn and of Cornell University. After leaving Cornell in 1897 he entered the employ of the Brooklyn Rapid Transit Company and in 1902 joined the staff of the Westchester Lighting Company, Mount Vernon, N. Y., which at that time was under the direct control of the United Gas Improvement Company, of Philadelphia. When in 1907 the Westchester corporation became affiliated with the interests controlling the Consolidated Gas Company, Mr. Hodgson joined the home engineering corps of the United Gas Improvement Company in Philadelphia and was subsequently detailed to St. Augustine, Fla. He remained for only a short time in that position, going from there to Gloversville, N. Y., as engineer of the electric division of the United Gas Improvement interests in Gloversville and Johnstown. His success was so marked that when the position of general manager of the Fulton County Gas & Electric Company became vacant through the resignation of Mr. L. D. Spragle he received the appointment. This position he held until his death.

Sir William Henry Preece, former engineer in chief and electrician of the British Post Office, and one of the highest authorities on telegraphy and telephony, died in London, Nov. 6. Sir William Henry Preece was born Feb. 15, 1834, near Carnarvon, North Wales. He completed a full course at Kings College, London, and studied electricity under Faraday at the Royal Institution. He was actively engaged in telegraph work from 1852 until the time he resigned from active service as consulting engineer of the Post Office Department in 1904 For sixteen years he was an employee of the Electric Telegraph Company, which existed prior to 1870, in which year the government took over the telegraph control of the country. His connection with the Post Office Department lasted over twenty-seven years. In 1852 Sir William, then Mr., Preece entered the office of the late Edwin Clarke, who was then chief engineer of the Electric Telegraph Company. From 1854 to 1856 he acted as assistant to Latimer Clarke and in the latter year was made superintendent of the southern district. During the early part of his career Sir William took out patents of a duplex system. In 1860 he was appointed by the London & Southwestern Railroad to be superintendent of the electrical system, and in 1870 he entered the post office service as division engineer for the south of England. In 1877 Sir William visited the United States in company with Sir Henry Fisher. The result of their investigations was the introduction of "sound reading" into England. He also brought over to England the system of quadruplex telegraphy. In 1884 he again visited the United States and when he returned to England introduced the multiplex system of telegraphy. In 1884 Sir William began experimenting with wireless telegraphy and worked out an electromagnetic system which was for a long time before the Marconi system in England in practical operation between Larvernock, near Cardiff, and Flatholm, an island in the British Channel, a distance of 3.5 miles. Sir William was for some years president of the Institute of Civil Engineers; he was a past-president of the Institution of Electrical Engineers (then the Society of Telegraph Engineers), a fellow of the Royal Society, a member of the Physical Society, the Meteorological Society, the Royal Institution, the British Association, the Society of Arts and an honorary member of the American Institute of Electrical Engineers and of the New York Electrical Society. His inventions, which were many, dealt with the telephone, Wheatstone apparatus, duplex, quadruplex and multiplex telegraph, wireless telegraphy and the electrical devices for increasing the safety of railway travel. He was a co-author of works on telegraphy and telephony and was one of the most prolific writers of scientific papers in the British Empire. His remarkable gifts as a lecturer on science brought him prominently before the general public of England. The papers presented by him before the different societies show the singularly wide range of subjects which he mastered and which through his great ability as a lecturer he was enabled to present to the best advantage. He was knighted on May 24, 1899.

SIR WILLIAM H. PREECE

Construction

New England

WEYBRIDGE, VT.—Thompson, Shaw & Co., owners of the local electric-lighting plant, expect to purchase within the next 18 months one 50-kw generator and within the next six months they expect to purchase 300 poles, 12 incandescent lamps with brackets, etc. H. L. Thompson is manager. Post office address, Weybridge, R. F. D. Middlebury.

NORTH ATTLEBORO, MASS.—The North Attleboro Electric Light and Water Department expects to install within the next six months two 150-hp horizontal tubular boilers. William Plattner is manager.

TAUNTON, MASS.—The finance committee of the Council has recommended that the manager of the municipal electric-lighting plant be authorized to purchase an additional water-tube boiler, to cost $5,200. M. C. Golden is manager.

PASCOAG, R. I.—At a special town meeting held Oct. 27 the taxpayers voted to appropriate $14,000 to renew the equipment in the municipal electric power plant, changing the system from 140-cycle, 1100-volt, single-phase, to 60-cycle, 2300-volt, three-phase, with duplicate generating units of 100 kw each with necessary switchboard equipment and line changes. The entire plant is practically being rebuilt with the exception of boilers. Improvements to the street-lighting system are in charge of a special improvement committee. J. Herbert Bailey is superintendent of the municipal electric-light plant.

BROAD BROOK, CONN.—The contract for street-lighting in Broad Brook, which is held by the Northern Connecticut Lt. & Pwr. Co., of Windsor Locks, expired Nov. 11. In the new contract it is expected that a provision will be made for changing the present street lamps for tungsten lamps.

Middle Atlantic

BUFFALO, N. Y.—Bids will be received by Francis G. Ward, commissioner of public works, Room 5, Municipal Building, Buffalo, until Nov. 28 for furnishing, setting up and connecting the scientific and mechanical equipment required in the completion of the new Technical High School building, located on the Bennett Park site, between Eagle and Clinton Streets, as follows: Mechanical equipment: (b) motors and generators; (c) shafting and hangers; (d) woodworking machinery; (e) metal-working machinery; (f) forge-shop equipment; (g) foundry equipment; (h) engineering laboratories; (i) applied-arts equipment; (j) pottery equipment; (k) shavings-exhauster equipment; (l) small woodworking tools; (m) small metal-working tools. Electrical work: (t) conduit and wiring. Science equipment: (n) science laboratories equipment; (o) domestic science and service-kitchen equipment. A separate and distinct proposal must be made for each division of the work under the different classifications. Plans and specifications are on file at the office of the deputy building commissioner, Room 6, Municipal Building, where blank forms of proposals and any desired information may be obtained.

NEW YORK, N. Y.—Bids will be received by the Department of Charities, foot of east Twenty-sixth Street, New York, until Nov. 17 for furnishing labor and materials for the installation of electric-wiring fixtures and gas piping at the city hospital building, Blackwell's Island. Bids must be submitted on the entire work. Blank forms and further information may be obtained at the office of Frank Sutton, 80 Broadway, New York, consulting engineer. Michael J. Drummond is commissioner.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, N. Y., until Nov. 17 for installing electric equipment in the addition to and alterations in Public School 71, on Forest Avenue, borough of Queens; also for installing electric equipment in new Public School 22, corner of Washington and Columbus Avenues, borough of Richmond. Blank forms, plans and specifications may be obtained or seen at the office of the superintendent, hall of the Board of Education, Park Avenue and Fifty-ninth Street, New York; also at branch offices, 69 Broadway, Flushing, borough of Queens, and Borough Hall, New Brighton, borough of Richmond.

ROCHESTER, N. Y.—The large power house of the Rochester & Sodus Bay Ry. Co. at Ontario was recently destroyed by fire, causing a loss of about $40,000.

WATERTOWN, N. Y.—The Public Service Commission has granted the Northern New York Utilities Co. permission to construct and operate a hydroelectric plant on Beaver River near Belfort. The company is also authorized to issue bonds to the amount of $248,000, to be sold at not less than 85, and $93,300 in capital stock to be sold at not less than par.

EDINBORO, PA.—Among the improvements contemplated by the Northwestern Pennsylvania Ry. Co., of Meadville, is the erection of a combined electric railway station and a substation (46 ft. by 76 ft.) in Edinboro. Niagara power will be used under the new system. In addition to furnishing energy to operate the street railway the new station will furnish electricity for lamps and motors.

PHILADELPHIA, PA.—Bids will be received at the office of George D. Porter, director Department of Public Safety, Room 215, City Hall, Philadelphia, Pa., until Nov. 21 for the following supplies for the Electrical Bureau: 2400 sq. ft., ¼-in. asbestos wood, J. M. Trasite, plain or equal; 48 one-lamp ceiling fixtures for first-floor corridor, City Hall; police telephone service and equipment for the use of the city of Philadelphia during the year 1914; Bell municipal telephone service and equipment for the use of the city of Philadelphia during the year 1914; Keystone municipal telephone service for the city of Philadelphia for 1914; one main distributing terminal and protector frame for fire-alarm circuits; 11,000 ft., 25 pair, No. 16 gage, paper-insulated, lead-incased cable, to be delivered at Thirty-first District police station, Twenty-sixth and York Streets; 10,500 ft., 25 pair, No. 16 gage, paper-insulated, lead-incased cable, to be delivered at Thirty-eighth District police station, Fifty-fifth and Pine Streets. Specifications for above may be obtained at the office of the Electrical Bureau, Room 618, City Hall.

ELLERSLIE, MD.—The Cooks Mills El. Lt. & Pwr. Co., of Ellerslie, expects to install within the next four or six months from 40 to 50 meters, and to purchase within the next four months electrical appliances and supplies, including wire, switches, lamps, etc. Daniel Deal is president.

NEW MARTINSVILLE, W. VA.—The Sistersville El. Lt. & Pwr. Co., of New Martinsville, is rebuilding the lighting system here and extending its distribution lines to suburbs. D. L. Evans is superintendent.

BLACKSBURG, VA.—The Virginia Polytechnic Institute hopes to purchase arc lamps and lamp-posts within the next year. D. O. Matthews is superintendent of the Heat and Power Department.

MANASSAS, VA.—Bids will be received by the town of Manassas until Dec. 5 for the installation of an electric-light plant, including poles, lines and wiring. Bids will also be received until Dec. 3 for furnishing materials and installing water-works and sewer systems. Copies of plans and specifications may be obtained upon receipt of $5, which will be refunded if plans are returned before Dec. 1. C. R. C. Johnson is chairman and N. Wilson Davis engineer.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 17, for an electrical apparatus and cable connecting the present plant of the Interior Department with the court of appeals and the old court house, Washington, D. C. Plans and specifications may be obtained upon application. Elliott Woods is superintendent of United States Capitol building and grounds.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Nov. 18, for furnishing at the various navy yards and naval stations the following supplies: Brooklyn, N. Y., Schedule 5975—50 detectors for radio receiving sets, one 5-kw radio transformer; Schedule 5981—81,000 ft. 0.102-in. diameter telegraph wire; Philadelphia, Pa., Schedule 5976—two switchboards and spare parts, 143 miscellaneous telephones and spare parts. Bids will also be received at the same place until Nov. 25 as follows: Mare Island, Cal., Schedule 5978—one electro-plating outfit; Schedule 5979—engine-room mechanical telegraph transmitters and indicators (two each); Brooklyn, N. Y., Schedule 5986—one combination electrically heated sterilizer, complete; Schedule 6006—130,000 ft. aerial, silicon bronze wire; Annapolis, Md., Schedule 5990—one oil-engine-driven, direct-current exciter unit. Applications for proposals should give the schedule desired by number.

North Central

ALBION, MICH.—Property owners on South Division Street are asking for an extension of the ornamental street-lighting system on that thoroughfare.

BOYNE FALLS, MICH.—The local electric-light plant has been purchased by W. J. Pearson, who has organized a company, known as the Boyne Falls Pwr. Co. It is expected that electricity will soon be furnished for motors as well as lamps. D. H. Hinckley, of Brutus, is also interested in the company.

DETROIT, MICH.—The Edison El. Illg. Co., of Detroit, has started work on the construction of a power plant at Connors Creek, where 40,000 hp will ultimately be developed.

HONOR, MICH.—The Betsey River Lt. & Pwr. Co., of Honor, has applied to the Village Council for a franchise to furnish electricity here. The company has completed its dam and, it is understood, will soon be ready to furnish electrical service. The proposed plant will cost about $100,000 and will develop about 1200 hp. J. L. Barker, cashier of the Benzie County Bank, of Honor, is interested in the project.

MONROE, MICH.—Orders have been placed by the Monroe Bindery Board Co. with the Allis-Chalmers Co. for two turbo-alternators.

ROSCOMMON, MICH.—Bonds to the amount of $4,500 have been voted for improvements to the electric-light and water-works plant.

CLEVELAND, OHIO.—Bids will be received at the office of the secretary of the director of public service, 204 City Hall, Cleveland, until Nov. 22 for a direct-connected motor-driven centrifugal pump for the city water department. Proposals must be submitted on blanks furnished by the superintendent of the water department. W. J. Springborn is director of public service and W. H. Kirby is secretary.

MIDDLE POINT, OHIO.—The France Stone Co. is contemplating the installation of electrical equipment at its Middle Point quarries.

PORT CLINTON, OHIO.—At the election held Nov. 4 the proposition to issue bonds for the construction of a municipal electric-light plant was

carried. For further information address the clerk of Board of Public Affairs.

SHILOH, OHIO.—At an election held recently the proposal to levy additional tax for a period of five years for the installation of an electric-light plant was carried.

HARRODSBURG, KY.—The proposal to issue $12,000 in bonds to provide funds for improvements to the municipal electric-light plant was carried at the election held Nov. 4.

LEXINGTON, KY.—At the election held Nov. 4 the voters defeated the proposed bond issue of $200,000 for the purpose of establishing a municipal electric-light plant.

LOUISVILLE, KY.—The General Construction Co., of Louisville, will install an electric plant in an apartment house it is building. The equipment will consist of three 75-hp horizontal return tubular boilers, down-draft furnaces, one 55-hp and two 75-hp steam engines, one 35-kw and two 50-kw generators with switchboard equipment for an isolated plant, switchboard meters and apartmen. meters and approximately 1700 incandescent lamps. Contracts for equipment and machinery have not yet been placed. A. M. Cowherd is engineer in charge of the work.

PARIS, KY.—The city of Paris is considering the question of establishing a municipal electric-light plant.

VARILLA, KY.—The Kentucky Utilities Co., of Lexington, has taken over the local electric-light plant, which was originally built to serve the various mines of T. J. Asher, on his 38,000-acre coal tract. This will be used by the company for the central plant in this district. Electricity will be transmitted at 33,000 volts to the mines of the Bell and Bath fields, with reserve stations at Middlesboro and Pineville.

ALBION, IND.—The Board of Public Works expects to purchase within the next six months about 4000 ft. three No. 10 lead-covered cable for street lamps and about 30 ornamental lamp-posts. A. Holderman is superintendent.

HUNTINGTON, IND.—At an election held Nov. 4 the proposition to issue bonds for the installation of a municipal electric-light plant was carried. H. I. Young is city clerk.

DUQUOIN, ILL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 19, for the construction, complete, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Duquoin. Drawings and specifications may be obtained at the above office or from the custodian of site at Duquoin. O. Wenderoth is supervising architect.

GRANVILLE, ILL.—Sidney Whitaker, owner of the local electric-light plant, expects to purchase within the next 30 days one 60-hp oil engine and two hoods for street lamps.

LA HARPE, ILL.—The installation of an ornamental street-lighting system is under consideration by the merchants of the city, using 16 standards in three blocks.

MANITO, ILL.—The contract for the construction of the new power house for the municipal electric-light plant has been awarded to R. A. Hilling & Co. As yet no other arrangements have been made for improvements to the municipal electric-light plant. William T. S. Beebe is superintendent.

MONTICELLO, ILL.—The Monticello El. Lt. & Pwr. Co. expects to install within the next five months substation equipment to take the place of its present generating apparatus (133 cycles). The company is now erecting about 1 mile of pole line and has recenly installed 75 service meters. Electrical cooking appliances and heating devices, etc., are purchased as required. John A. Glover is general superintendent.

PEORIA, ILL.—The Association of Commerce has instructed Secretary Palding Slevin of the publicity committee to secure estimates on a large search-lamp for advertising purposes; also estimates for an electric sign "Welcome to Peoria," with letters 20 ft. high.

PEOTONE, ILL.—The Peotone El. Co. expects to purchase within the next six months series street-lighting equipment and 20 ornamental lamp-posts carrying five-lamp clusters. H. Fedde is manager.

SPRINGFIELD, ILL.—A committee of business men has submitted a plan to Willis J. Spaulding, city commissioner, for the extension of the ornamental street-lighting system in the business district when the city enters the commercial lighting field.

STERLING, ILL.—The Northwestern Barb Wire Co., of Sterling, expects to purchase a centrifugal pump for its electric power plant. P. W. Dillon is secretary.

STERLING, ILL.—The light committee of the City Council has engaged H. S. Green, general manager of the Rock River Lt. & Pwr. Co., of Sterling, to prepare plans for the new ornamental street-lighting system for the business district of the city. The plans provide for 14 blocks.

WARSAW, ILL.—The Keokuk El. Co. has submitted a proposal to the City Council for the installation of an ornamental street-lighting system in Warsaw. Three different plans have been submitted.

GRAND RAPIDS, WIS.—The Consol. Wtr. Pwr. & Paper Co. may possibly install in the near future one or more 60-cycle generating units, switchboard, transformers, motors, etc., and remodel some of the boilers. Nothing definite has yet been decided upon. C. L. Hayward is electrical engineer.

LA CROSSE, WIS.—The Wisconsin Ry., Lt. & Pwr. Co., of La Crosse, expects to erect within the next six months a new substation.

MADISON, WIS.—The Peninsular Pwr. Co., of Madison, expects to erect within the next six months an extension to its 66,000-volt transmission line and to purchase boilers and turbo-generators for an output of about 1000 hp.

MAUSTON, WIS.—The Mauston El. Ser. Co. expects to purchase within the next six months one 150-hp steam engine and boiler complete. J. E. Carroll is manager.

MINERAL POINT, WIS.—The Mineral Point Pub. Ser. Co. expects to install within the next 30 days a 1200-kw Westinghouse (Bluder type) generator, La Blanc condenser and stoker, cooling tower and another Heine boiler. F. C. Ludden is president.

MOSINEE, WIS.—The Mosinee El. Lt. & Pwr. Co. expects to purchase one transformer. W. A. Von Berg is treasurer.

MOUNT HOREB, WIS.—The Mount Horeb Ht., Lt. & Pwr. Co. expects to purchase within the next two months one 75-hp producer-gas engine and one 50-kw, three-phase, 60-cycle, 2200-volt generator, directly connected. M. Mathison is president.

OAKFIELD, WIS.—The Oakfield Lt. & Pwr. Co. expects to purchase within the next 20 months a 10-kw to 12-kw generator and engine.

BLACKDUCK, MINN.—The question of purchasing the local electric-light plant and telephone exchange, owned by the Blackduck El. & Tel. Co., to be owned and operated by the municipality, is under consideration. M. D. Stoner is president of the company.

CHISHOLM, MINN.—The controlling interest of the Chisholm El. Co. has been purchased by Knox-Heskett Co., of Chicago, Ill., and associates. It is understood that extensive improvements are contemplated to the plant and system. Among the new directors are: Neal Brown, of Wausau; R. M. Heskett, of Chicago, Ill., and Charles Meyers, of Wausau, Wis. Albert Sandt still retains his interest in the company.

SWANVILLE, MINN.—The Village Council has granted a franchise to Albert Mielke to construct and operate an electric-light plant in Swanville.

WATERTOWN, MINN.—Plans are being prepared for construction of an electric-power plant in Watertown. A company is being organized by Guy E. Halgren and James J. Donsford to operate same.

ANAMOSA, IA.—William G. Dows, Isaac B. Smith and John A. Reed, of Cedar Rapids, recently granted a franchise in Anamosa, contemplate the purchase of the old electric plant in Anamosa and to connect same with their Cedar Rapids plant and furnish electricity for lamps and motors here. L. J. Fisher is city clerk.

BLOOMFIELD, IA.—The Burlington El. Ry. Co. has submitted a proposal to the City Council offering to purchase the municipal electric-light plant.

DUBUQUE, IA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 1 for changes in plumbing, conduit and wiring system and lighting fixtures in the United States custom house and post office in Dubuque. For details see proposal columns. O. Wenderoth is supervising architect.

DUNKERTON, IA.—J. A. Renz has been granted a franchise to construct and operate an electric-light plant in Dunkerton.

GILBERTSVILLE, IA.—The Gilbertsville Ltg. Co., recently incorporated, is reported to be contemplating the construction of an electric-light plant in Gilbertsville. R. W. Allen is president.

LE MARS, IA.—At an election held recently the proposition to grant the Le Mars Wtr. & Lt. Co. a 25-year franchise to furnish water and light in Le Mars was defeated. The franchise expired Oct. 1.

PELLA, IA.—The city of Pella expects to purchase within the next two months cable for underground distribution in connection with the municipal electric-light plant. A. C. Kuyper is manager.

THORNTON, IA.—The question of installing an electric-light system in Thornton is under consideration.

NEW LONDON, MO.—Bids will be received by the North Missouri Lt. & Pwr. Co., of New London, until Nov. 21 for furnishing material and construction of approximately 35 miles of 33,000-volt, three-phase transmission lines. Plans and specifications may be obtained from J. D. Lane, of New London, or the Fuller-Coult Co., Chemical Building, St. Louis, Mo., engineers.

GRAND FORKS, N. D.—Bids will be received by the Board of County Commissioners of Grand Forks County, at the office of the County Auditor, Grand Forks, until Nov. 25 for conduits, electric light and power wiring and telephone conduits for the Grand Forks County court house, in Grand Forks, according to plans and specifications prepared by Buechner & Orth, architects. Hans Anderson is county auditor.

PLAZA, N. D.—Application has been made to the town of Plaza by B. C. French for a franchise to construct and operate an electric-light plant here.

BLUNT, S. D.—The Blunt Lt. & Pwr. Co. expects to purchase within the next six months a few vacuum cleaners, washing machines and wiring supplies. C. E. Gunsalus is engineer and manager.

WHITE, S. D.—Application has been made to the City Council for a franchise by George Baisley, of White, to install and operate an electric-light plant here.

FULLERTON, NEB.—If the application of the Fullerton El. Lt. & Pwr. Co. now pending before the board of irrigation is acted on favorably, the company will install new equipment in a water-power plant.

The same will probably be completed within the next 12 to 16 months. C. N. Philbrick is secretary.

COTTONWOOD FALLS, KAN.—The Home Lt. & Pwr. Co., of Cottonwood Falls, expects to install within the next four months one 100-hp (150-lb. pressure) tubular boiler. W. W. Austin is manager.

GOODLAND, KAN.—The Goodland Lt. & Pwr. Co. expects to install within the next two months one 75-kw, three-phase, 2300-volt generator belted to a 60-hp Muncie oil engine. William H. Frazier is manager.

GYPSUM, KAN.—The Gypsum Lt. & Pwr. Co. expects to purchase within the next four months a 25-hp or 30-hp oil engine, underground conduit for ornamental street-lighting system and ornamental lamp standards. It also will soon purchase heating and cooking apparatus, washing machines and electric irons. R. O. Keys is president.

HARPER, KAN.—Within the next six months the managers of the municipal light and water plant expect to purchase a motor and pump for the water plant. A. M. Carter is superintendent.

HAVEN, KAN.—The Haven El. & Ice Co. expects to enlarge its ice plant and to purchase a 5-ton ice vat. The ice plant is operated in connection with the electric plant.

HIAWATHA, KAN.—The Hiawatha El. Lt. Co. expects to build within the next two months a 15-ton ice plant, to be operated in connection with the electric-light plant. R. H. Love is secretary and manager.

OSAWATOMIE, KAN.—The Electric Light Commission expects to purchase within the next six months one ground detector, one synchronizer for parallel operation, and about 20,000 ft. No. 8 weather-proof wire. B. L. Prier is superintendent.

Southern States

CHARLESTON, S. C.—The Charleston-Isle of Palms Trac. Co., of Charleston, expects to erect within the next two months a substation at Mount Pleasant, to be equipped with two 300-kw rotaries, 6600-volt primary, 600-volt secondary (railway). Arrangements have already been made for purchase of equipment. W. W. Fuller is chief engineer and general superintendent.

PUNTA GORDA, FLA.—At an election to be held Dec. 2 the proposition to issue $75,000 in bonds, the proceeds to be used for extensions to electric, water and sewers systems, will be submitted to the voters.

NASHVILLE, TENN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 25 for a new hoistway, an electric freight lift, etc., for the United States post office and custom house at Nashville, Tenn., in accordance with specifications, copies of which may be obtained at the above office. O. Wenderoth is supervising architect.

HUNTSVILLE, ALA.—The Alabama Pwr. Co., it is reported, has decided to establish one of its steam plants in Huntsville. The proposed plant will cost about $1,250,000 and will furnish electricity in Huntsville and throughout a large territory in Madison and adjoining counties.

MUSKOGEE, OKLA.—The Sequoyah Club is reported to have awarded a contract to Joseph Dickman to construct a concrete dam 6 ft. high across the Illinois River. Later the club contemplates the installation of a waterwheel and generator to furnish electricity for lighting the clubhouse, cottages and grounds.

EASTLAND, TEX.—The Eastland Lt. & Pwr. Co. expects to erect within the next two months a power house. The company has recently purchased an engine and generator. A. A. Abney is manager.

HALLETTSVILLE, TEX.—The city of Hallettsville expects to purchase within the next six months a street-lighting system and 100 ceiling and desk fans. T. J. Buchanan is city engineer and electrician.

JACKSONVILLE, TEX.—The Jacksonville Ice & El. Co. expects to install within the next few months a 200-kva, 60-cycle, 2200-volt generator directly connected to an oil engine, or possibly a steam engine, and also 600 hp in new boilers. The company recently installed a series street-lighting system throughout the entire town.

LAREDO, TEX.—The Laredo El. & Ry. Co. expects to purchase within the next few months either a steam turbine or oil engine and stoker for boiler room; also new incandescent street-lighting system. Frank E. Scoville is secretary and manager.

MIDLOTHIAN, TEX.—The Ice, Wtr. & Lt. Co., of Midlothian, expects to purchase within the next two months 20 meters, 2000-lb. weather-proof wire and 12 lightning arresters, and within the next 12 months it expects to purchase 50 electric irons, six electric fireless cookers, six vacuum cleaners and general wiring supplies to the amount of $2,000. The company has just purchased one carload of poles. Charles J. Muller is manager.

MOUNT PLEASANT, TEX.—The Mount Pleasant El. Co. expects to reconstruct its overhead system, install series lighting system, furnish electricity to pump the city water and rebuild its plant within the next three months. Charles A. Bergen is manager.

NAVASOTA, TEX.—The Navasota Lt. & Pwr. Co. expects to purchase within the next four months a coal-conveying system to carry coal from car to boiler house, a distance of about 100 ft. R. W. Horlock is treasurer.

POST CITY, TEX.—The Post Pwr. Co. may decide to establish a complete lighting system for the town. As yet nothing definite has been decided upon. H. W. Fairbanks is vice-president and general manager.

SAN SABA, TEX.—The San Saba Lt. & Ice Co. expects to purchase wihin the next three months a 100 to 125-kw generating unit, consisting of engine and generator and generator switchboard panel for above generator. F. B. Hall is manager.

TOYAH, TEX.—The Toyah El. Lt. Co. expects to purchase within the next few months a 25-hp internal-combustion engine.

VERNON, TEX.—The Texas Public Service Co. expects to erect a short 2300-volt transmission line and to purchase an alternating-current, 2300-volt generator and engine; also usual line of electrical supplies, including heating and cooking apparatus, vacuum cleaners, washing machines, etc. A. E. Gilman is business manager.

WALNUT SPRINGS, TEX.—The managers of the municipal electric-light plant expect to erect within the next two months a transmission line from Waco to Walnut Springs, to obtain electricity from the Waco plant; also to purchase the independent telephone line between Walnut Springs and Waco.

Pacific States

HANFORD, WASH.—The Hanford Irrigation & Pwr. Co. expects to purchase medium quantities of lamps, heating devices and electrical wiring supplies. E. F. Benson is receiver of the company.

LEBAM, WASH.—Plans are being prepared by R. L. Fisher, of Raymond, for the installation of an electric-lighting system in Lebam. Electricity for operating the system will be supplied by the Lebam Mill & Timber Co.

MEDICAL LAKE, WASH.—The Okanogan Valley Pwr. & Lt. Co. expects to erect a small power house on the Methow River and to erect 30 miles of 22,000-volt transmission line, connecting Brewster and Okonogan, within the next six months; also to purchase within the next three months a 250-kw generator, switchboard panels, three 125-kva, 22,000-volt transformers, one pair of 35-in. waterwheels, exciter and waterwheel governor. Eugene Enlow, of Medical Lake, is president.

MONTESANO, WASH.—The City Council has authorized the installation of new street lamps on Kamilche, Church, Cedar and State Streets. Bids for the work, it is understood, will soon be asked for.

MORTON, WASH.—The City Council has granted a franchise to F. M. Broadbent to construct and operate an electric-light plant in Morton for a period of 49 years.

PROSSER, WASH.—Work will soon begin on the extension of the transmission lines of the Pacific Pwr. & Lt. Co. along the Model Orchard Road, a distance of several miles.

SEATTLE, WASH.—The Puget Sound Trac., Lt. & Pwr. Co., of Seattle, is contemplating the erection of a transmission line from Georgetown into the Black River district, to furnish electricity for lamps and motors to the ranchers in that vicinity.

SEATTLE, WASH.—The water-power rights on the Skagit and Cascade Rivers for which permits were recently granted by Secretary Houston of the Department of Agriculture to the Skagit Pwr. Co. have been purchased by the Stone & Webster Corpn., of Boston, Mass. It is understood that a hydroelectric plant to develop 50,000 hp will be erected at a cost of about $5,000,000. Electricity generated at the plant will be transmitted to Seattle.

TACOMA, WASH.—Plans have practically been completed by B. W. Collins, electrical superintendent, for the installation of an ornamental street-lighting system in the business district. An ordinance providing for creating an improvement district to install the lamps will soon be introduced in the City Council.

WASHOUGAL, WASH.—The Western Lt. & Pwr. Co., of Washougal, expects to install within the next 30 days one Woodward waterwheel governor. The company is rebuilding part of its distribution system and will make extensions of approximately 3 miles. C. W. Cottrell is president.

CORVALLIS, ORE.—The Oregon Pwr. Co. has submitted a proposal to the City Council offering to install 145 electric lamps of 100 cp in place of the 52 arc lamps now in use. The company offers to install the lamps at its own expense and maintain the lamps for the same amount that is now expended for street-lighting, provided a five or ten-year contract is signed.

LEBANON, ORE.—The Lebanon El. Lt. & Wtr. Co. expects to erect within the next three months 22 lamp standards, carrying five-lamp clusters, to be operated on 6.6-amp series system. Orders have been placed for posts and wire. S. I. Stewart is manager.

BURLINGAME, CAL.—Plans have been adopted by the Board of Trustees for the installation of a new street-lighting system in both the business and residence sections. Electroliers maintained by underground wires will be erected in the business district.

CALISTOGA, CAL.—The State Railroad Commission has granted the Napa Valley El. Co., of St. Helena, permission to purchase the property of the Calistoga El. Co. and to issue $20,500 in bonds, $15,300 in capital stock and $5,000 in notes, the proceeds to be used to take over the properties and to provide for extensions and improvements.

FILLMORE, CAL.—Surveys are being made by J. A. Heaston and Constant W. Booth, of Huntington Park, civil engineers, at Bradfield's

Camp on the Big Sespe for the proposed hydroelectric power plant to be built by the Sespe Lt. & Pwr. Co., recently incorporated. The company has filed on 10,000 in. to be diverted from the stream. It is proposed to build several dams across the stream and impound the floodwaters.

LOS ANGELES, CAL.—The City Council has adopted a report recommending an appropriation of $1,500 to cover the cost of employing three experts to report on the aqueduct bureau, which report is to be given to the public before the coming bond election. George L. Hoxie, 50 East Forty-first Street, New York, N. Y.; Prof. C. L. Corey, of the State University, and C. W. Koiner, manager of the Pasadena municipal electric plant, will report on the cost of a municipal electrical distribution system for aqueduct power, cost of operating the system, etc. E. F. Scattergood, of the power bureau, will be required to submit an estimate of the cost of a distributing system for street-lighting.

SAN DIEGO, CAL.—The State Railroad Commission has authorized the San Diego Consol. Gas & El. Co. to issue $27,000 in bonds, the proceeds to be used for additions and improvements to its plant.

SAN LUIS OBISPO, CAL.—The Midland Counties Pub. Ser. Corpn., of San Luis Obispo, expects to install within the next three months one set of 66,000-volt lightning arresters. George L. Howard is district agent.

SANTA CRUZ, CAL.—The city of Santa Cruz expects to install a 15-ton incinerator in the old municipal power station, at a cost of about $6,000. It also expects to purchase through the Coast Counties Gas & El. Co. an additional 50-lamp luminous-arc rectifying set together with lamps and cut-outs. J. C. Geyer is superintendent of Electric Department.

MOSCOW, IDAHO.—Preliminary surveys are being made by the Washington Wtr. Pwr. Co., of Spokane, with a view of extending its transmission lines immediately from Palouse, Wash., to Moscow. Small towns, including Troy and Kendrick, along the route of the transmission line will be furnished with electrical service.

CLIFTON, ARIZ.—The Arizona Copper Co., of Clifton, is now installing transformers (625 kva) in the Clifton substation; equipment has already been purchased. The company has recently completed a 6000-kva generating plant and distribution lines to its mines and properties, and will need general line and construction material such as is used in power and lighting installations. As yet nothing definite has been decided upon. Hammond Matthews is chief electrician.

DAYTON, WYO.—The town of Dayton expects to purchase within the next six months incandescent lamps for the municipal electric-light system. M. M. Owen is town clerk.

LA JUNTA, COL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 18 for construction, complete, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at La Junta. Drawings and specifications may be obtained at the above office or from the custodian of site at La Junta. O. Wenderoth is supervising architect.

Canada

EDMONTON, ALTA.—R. H. Parsons, superintendent of the municipal electric plant, has recommended the purchase of a 400-kw generator to be operated by a Belliss & Morcom engine, with condensing equipment.

HALIFAX, N. S.—The Halifax El. Tramways Co., Ltd., has been granted permission by the Public Utilities Commission to issue 6000 shares of capital stock at par, the proceeds to be used for extensions and retirement of bonds.

ELORA, ONT.—The by-law to contract with the Hydro-Electric Power Commission for 200 hp and authorizing an expenditure of $10,000 for the installation of a distribution system for same was carried.

FERGUS, ONT.—The by-law providing for power from the Hydro-Electric Commission and authorizing an expenditure of $16,000 for the installation of a complete distribution system for the town was carried. The proposed transmission line will connect with the Prison Farm near Guelph, and the substation will be located near the House of Industry property, about half way between Fergus and Elora.

FORT WILLIAM, ONT.—The City Council has deposited with the Public Works Department plans for 500,000-circ mil, subaqueous armored cable for conveying electrical energy at 556 volts, direct current, from the power plant of the Kaministiquia Pwr. Co. across the Kaministiquia River to Island 2, to furnish electricity for operating the extension of the municipal street railway.

IROQUOIS, ONT.—The Beach Hydro-Electric System has a customer for a second-hand 50-hp, 60-cycle, 2300-volt motor (must be in first-class condition). M. W. Beach is manager.

LONDON, ONT.—The by-law authorizing an expenditure of $700,000 for equipping the London & Port Stanley railway for electrical operation was passed by the ratepayers on Oct. 22.

LONDON, ONT.—The city of London Hydro-Electric System expects to erect within the next three months an addition to the No. 1 substation (three stories high) to provide space for a 1500-kw rotary converter and auxiliaries to furnish power for the street-railway system. E. V. Buchanan is electrical engineer.

LONDON, ONT.—Negotiations have practically been completed between the London Street Ry. Co. and the City of London Hydro-Electric System whereby the company will use hydroelectric power, the terms being that the company shall take a minimum of 1000 hp. In order to convert the energy from alternating current to direct current for street-railway use a rotary converter will have to be installed at a cost of about $20,000. The agreement is for a period of 12 years.

ST. CATHARINES, ONT.—The by-law authorizing an expenditure of $116,000 for the construction of substation and distribution system for the use of electricity to be supplied by the Hydro-Electric Power Commission of Ontario was passed on Oct. 30. The plans provide for a 2000-hp system. The transmission line will be erected by the Hydro-Electric Power Commission. W. P. Near is city engineer.

SMITHVILLE, ONT.—H. Gracey, of Smithville, is said to be considering the installation of a small electric plant driven by a gasoline engine, with storage battery auxiliary.

QUEBEC, QUE.—The Battlefields Park Commission has awarded the contract for lighting Battlefields Park to the Quebec Ry., Lt., Ht. & Pwr. Co.

YORKTON, SASK.—Tenders will be received by T. F. Acheson, secretary and treasurer of the town of Yorkton, until Dec. 22 for a 500-hp generating unit driven by a Diesel engine. For details see proposal columns. M. M. Inglis, of Yorkton, is electrical engineer.

Miscellaneous

FAIRBANKS, ALASKA.—The Canadian-Klondike Mining Co., which owns a number of electric plants in this vicinity, is contemplating extending its transmission lines from Dawson to Fairbanks, via the Forty Mile, Eagle and Circle districts, plans for which are now being formulated.

JUNEAU, ALASKA.—W. L. Lass, superintendent, and R. P. Kennedy, assistant superintendent of the Treadwell Mines, of Treadwell, are contemplating organizing a company for the purpose of constructing a large hydroelectric power plant in the Long Lake and Speed River district, near Juneau.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Nov. 24, for furnishing operating devices for monitor sashes, transformers, brass tubing, reinforcing steel bars, steel cable, steel wire, etc. Blank and general information pertaining to this circular (No. 807) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

New Incorporations

SEBREE, KY.—The Warren Lt. & Pwr. Co. has been organized by G. H. Warren and others for the purpose of establishing an electric-light plant in connection with the plant of the Warren Milling Co.

FARMINGTON, MAINE.—The Franklin Lt. & Pwr. Co. has been incorporated with a capital stock of $750,000 to develop water-power plants, etc. The officers are: A. L. Fenderson, president, and C. O. Sturtevant, treasurer, of Farmington.

NEW PHILADELPHIA, OHIO.—The Ohio Ltg. Co. has been incorporated with a capital stock of $50,000 by W. A. Reiser, C. H. Slinghuff, M. Seibold, W. B. Gregson and William Schweitzer.

YOUNGSTOWN, OHIO.—The Mahoning County Lt. Co. has been granted a charter with a capital stock of $10,000. The incorporators are: Harry Engle, P. J. O'Neil, S. S. Conroy, L. A. Manchester and others. The company was recently granted a franchise in Youngstown on the condition that it would install a plant and have it in operation within two years.

KEIFER, OKLA.—The Keifer Lt. & Ice Co. has been incorporated by Charles H. Shone, Charles E. Petty, of Keifer, and D. W. Franchot, of Tulsa. The company is capitalized at $20,000.

AUBURN, PA.—The West Brunswick Lt., Ht. & Pwr. Co. has been chartered with a capital stock of $5,000 to operate in West Brunswick. The incorporators are: H. R. Carl, D. W. Nagle and B. K. Carl, of Auburn. The head office of the company will be located in Auburn.

PORT CLINTON, PA.—The Port Clinton Lt., Ht. & Pwr. Co. has been granted a charter with a capital stock of $5,000 to operate in Port Clinton. The incorporators are: H. R. Carl, D. W. Nagle and B. K. Carl. The offices of the company will be located in Auburn.

ROBSTOWN, TEX.—The Robstown Lt. Co. has been incorporated with a capital stock of $25,000 by R. R. McNeil, E. R. Sutherland and W. E. Pope.

TOLT, WASH.—The Tolt Wtr., Lt. & Pwr. Co. has been incorporated with a capital stock of $70,000 by R. B. McAdams and Robert McMurchie.

COOKSHIRE, QUE.—The Westbury El. Lt. & Pwr. Co. has been incorporated by Henry Alvin Worby, George W. Allard, Robert C. Cowling, Orin A. Osgood, Robert Bartholomew, Edward J. Planche and Cyrus M. MacRae. The company is capitalized at $75,000.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV. 4, 1913.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,077,278. PRINTING TELEGRAPH SYSTEM AND ALPHABET; D. S. Hulfish, W. J. Herdman and E. S. Lorimer, Toronto, Ontario, Canada. App. filed March 2, 1911. Employs small number of operating electromagnets and relatively larger number of printing types.

1,077,301. CAPPING TOOL; D. M. Resslar and F. Butler, Mount Vernon, Ohio. App. filed Feb. 8, 1913. For severing glass cylinders; has means for tensioning the heating wire which encircles the cylinder.

1,077,307. ELECTRIC HORN; R. R. Root, Cleveland, Ohio. App. filed March 31, 1913. Outstanding post on diaphragm is struck by armature which is supported on a spring tongue.

1,077,319. MEANS FOR CONTROLLING ELECTROMAGNETS AND SOLENOIDS; L. L. Tatum, Milwaukee, Wis. App. filed June 16, 1910. Prevents sticking of the plunger or armature of an electromagnet, particularly alternating-current, by inserting a resistance in parallel with the control switch.

1,077,355. ALTERNATING-CURRENT ELECTROMAGNETIC CONTROLLER; D. L. Lindquist, Yonkers, N. Y. App. filed March 3, 1911. Reduces volume of current required in starting, particularly for elevator work.

1,077,369. FUSE; E. E. Roberts, Hartford, Conn. App. filed Dec. 28, 1911. Inclosed type; relatively fine inner granular filling and a coarser outer granular filling which absorb and cool the gases evolved at fusing and vent the cooled gases.

1,077,372. ELECTRICALLY HEATED SADIRON; C. A. Shaler, Waupun, Wis. App. filed Feb. 12, 1912. Thermostat controls main and auxiliary heating coils without breaking the circuit.

1,077,374. DYNAMO-ELECTRIC MACHINE; C. E. Skinner and T. S. Scott, Wilkinsburg and Pittsburgh, Pa. App. filed Jan. 16, 1906. End portions of the armature winding which project from the core slots are supported in an annular bracket.

1,077,380. QUICK-BREAK SWITCHING MECHANISM; H. G. Wellman, Cleveland, Ohio. App. filed Feb. 5, 1912. Arcing at the contacts prevented by causing magnets temporarily to hold the switch levers closed until after the cams or other switch-closing devices have moved out of engagement with the levers.

1,077,395. MECHANICALLY OPERATED ACCELERATING MECHANISM; W. Deats, Yonkers, N. Y. App. filed Dec. 16, 1908. Particularly for alternating-current elevator motors; acceleration of motor effected by series of mechanically operated switches controlled by the motor itself.

1,077,398. ELECTRIC FOG-SIGNAL LIGHT; R. C. Douglas, San Francisco, Cal. App. filed Oct. 24, 1912. Slidable electrode holder with automatic means for feeding and retracting the same.

1,077,429. ELECTRICAL MEASURING INSTRUMENT; W. H. Pratt, Lynn, Mass. App. filed Aug. 14, 1911. Prevents the leakage flux from one element from affecting the other element of an instrument for measuring multi-circuit systems.

1,077,444. ELECTROLYTIC DIAPHRAGM; H. A. Wagner, New York, N. Y. App. filed May 3, 1912. Porous material containing metallic mercury in finely divided state and manganese dioxide.

1,077,451. ELECTRICAL CONTROLLING AND REGULATING APPARATUS; G. T. Ashley, Santa Monica, Cal. App. filed Dec. 13, 1909. Auto-starter which cannot be left in the "start" position or any other position except the "off" or "run" position.

1,077,479. DEVICE ADAPTED TO SHOW WHETHER AN ELECTRIC INCANDESCENT LAMP HAS BEEN IN USE; S. Klein, Berlin, Germany. App. filed March 17, 1910. Light-sensitive body incorporated in the lamp to indicate whether or not the lamp has ever been used.

1,077,503. AUTOMATIC VALVE; E. V. Anderson, Monesson, Pa. App. filed Oct. 18, 1911. Electrically controlled pilot valve controls flow of pressure to quick-operating supplementary valve.

1,077,507. ELECTRIC STORAGE DEVICE; H. P. Ball, Pittsfield, Mass. App. filed March 11, 1912. Has heat storage units which may readily be removed to the place where the heat is to be utilized.

1,077,539. BATTERY BOX; C. A. Mahla, New York, N. Y. App. filed March 6, 1913. Circuit-closing springs on the inside of the cover of the box eliminate need for any wiring connections.

1,077,558. TROLLEY-POLE RETRIEVER; C. B. Rodgers and J. A. Brennan, Bordentown, N. J. App. filed June 14, 1912. Pressure-operated device for depressing trolley pole when trolley wheel leaves the wire.

1,077,613. CONTROLLER FOR ELECTRIC MOTORS AND SIMILAR DEVICES; H. W. Leonard, Bronxville, N. Y. App. filed July 11, 1903. Motor starter, speed regulator and automatic protective devices are interlocked so that the several elements constituting the controller can be operated only in the proper sequence.

1,077,614 AND 1,077,615. CONTROLLER FOR ELECTRIC MOTORS AND SIMILAR DEVICES; H. W. Leonard, Bronxville, N. Y. App. filed July 11, 1903. Interlocking arrangement of starter, speed regulator and protective devices.

1,077,626. ALTERNATING-CURRENT APPARATUS; R. D. Mershon, New York, N. Y. App. filed April 27, 1910. Provides means whereby polyphase electrical apparatus may be operated on single-phase circuits.

1,077,627. ELECTROLYTIC CONDENSER; R. D. Mershon and J. S. Riddile. New York, N. Y. App. filed Dec. 14, 1910. Electrically connected collecting electrodes arranged at the ends of a series of side-by-side filmed electrodes.

1,077,628. ELECTROLYTIC CONDENSER; R. D. Mershon, New York, N. Y. App. filed Oct. 27, 1909. Transformer connected to the condenser electrodes, rectifier connected between the electrolyte and the transformer, and a battery in parallel with the rectifier.

1,077,635. ELECTRICAL RESISTANCE UNIT; E. J. Ovington, Los Angeles, Cal. App. filed March 3, 1911. Coiled resistance element screwed through perforations in a flat insulating sheet.

1,077,658. HEATING UNIT; F. M. Vogel, Pittsfield, Mass. App. filed June 12, 1913. For electric ranges; resistance element carried by cross strips loosely supported by angular side strips.

1,077,662. MOTOR-CONTROL SYSTEM; W. C. Yates, New York, N. Y. App. filed July 2, 1912. Overload device inoperative during starting of motor and an electromagnetic device inactive during starting of motor and actuated by the motor current for rendering the overload device operative.

1,077,674. PRODUCTION OF REFRACTORY CONDUCTORS; W. D. Coolidge, Schenectady, N. Y. App. filed Sept. 23, 1908. Makes tungsten filament by heating a shaped wire of tungsten powder and a binder of cadmium, mercury and bismuth in a current of gas to remove exuded metal and prevent the formation of surface globules.

1,077,676. ELECTRIC HEATER; A. S. Cubitt, Pittsfield, Mass. App. filed Sept. 21, 1910. Sectional heater made up of mechanically connected channel supports each having a resistance suspended therein from the web member thereof and terminals extending up through the web member.

1,077,706. RANGE TRANSMITTER; J. L. Hall, Schenectady, N. Y. App. filed June 27, 1910. Embodies synchronously operating motors at sending and receiving stations with frictionally driven indicator at receiving station and electrically controlled latches for the same.

1,077,711. HIGH-POTENTIAL INSULATOR; E. M. Hewlett, Schenectady, N. Y. App. filed May 5, 1908. Insulator post with angularly adjustable metallic cap coupled to the end of the post.

1,077,717. MOTOR CONTROL; W. P. Jackson, Oakland, Cal. App. filed June 18, 1912. In accelerating, when a certain predetermined speed is reached the field strength is automatically reduced to increase further the motor speed.

1,077,729. SYSTEM OF ELECTRIC METERING; K. Markau, Berlin, Germany. App. filed July 23, 1912. Metering system designed to induce consumers to use electricity freely for industrial and heating purposes during the period of light load but to discourage consumption of energy for such purposes during the period of peak load.

1,077,734. TERMINAL FOR METAL-SHEATHED WIRE; C. N. Moore, Schenectady, N. Y. App. filed Jan. 18, 1913. End portion of the sheath is disconnected from the body of the sheath, and the inner working conductor is then connected to this disconnected terminal portion of the sheath.

1,077,737. MOTOR-CONTROL SYSTEM; E. J. Murphy and J. E. Brobst, Schenectady, N. Y. App. filed June 20, 1912. Dynamic braking system for stopping motors quickly and safely.

1,077,739. TRAIN STOP; A. R. Mutton, Waterloo, Ia. App. filed July 1, 1912. Cab-signal system with air-brake connections.

1,077,746. SNAP-SWITCH; J. G. Peterson, Hartford, Conn. App. filed Sept. 22, 1911. Rotary snap-switch with special commutator assemblage and special support for the stationary switch blades.

1,077,749. MAXIMUM-DEMAND ELECTRIC METER; W. E. Porter, Lynn, Mass. App. filed Feb. 19, 1910. Embodies a meter, a differential gear, a clockwork mechanism and a dial pointer.

1,077,792. VOLTAGE REGULATOR; W. S. Bralley, Schenectady, N. Y. App. filed July 30, 1908. Includes an electrolytic cell of the aluminum type in a circuit parallel to the circuit including the field winding of the generator.

1,077,802. MOTOR-CONTROL SYSTEM; F. E. Case, Schenectady, N. Y. App. filed July 16, 1912. Obtains low voltage for control circuit without use of a dynamotor by connecting a resistance across the supply circuit and connecting the control circuit at some intermediate point on the resistance.

1,077,817. STARTING DEVICE FOR ELECTRIC MOTORS; P. Dunning, Schenectady, N. Y. App. filed June 27, 1911. Control switch is automatically operated upon by the closing of a control circuit, as by means of a pressure gage or float switch.

1,077,829. CIRCUIT-BREAKER; A. Guerra, Celaya, Mexico. App. filed Sept. 11, 1912. Includes a longitudinally expansible rod surrounded by a heating coil.

1,077,866. ELECTRICALLY HEATED COOKING DEVICE; H. P. Ball, Pittsfield, Mass. App. filed June 8, 1912. Has a broiling chamber with a heating unit in the top of the same and a cooking vessel removably supported upon the heating unit.

1,077,877. CIRCUIT-CLOSING DEVICE FOR DOORS; W. H. Fitch, Fort Worth, Texas. App. filed March 7, 1913. Includes a spring-pressed push rod and a pivoted abutment plate for the same, carried by the door.

1,077,894. ELECTRODE; R. H. Stevens, Salt Lake City, Utah. App. filed Sept. 29, 1911. Platinum-plated tungsten electrode for lighting, electroplating, batteries and electro-metallurgy.

1,077,895. SYSTEM FOR ELECTRICALLY CONTROLLING AND OPERATING RAILWAY-TRAFFIC-CONTROLLING DEVICES; H. B. Taylor, Albany, N. Y. App. filed Aug. 12, 1910. Involves use of primary and secondary sources of energy of different potential.

1,077,913. HAMMER ACTION FOR MUSICAL INSTRUMENT; Sarah M. Keyte, Oakland, Cal. App. filed Oct. 8, 1912. Electro-pneumatically operated and controlled.

1,077,914. COMMUTATOR; R. E. Noble, Chicago, Ill. App. filed July 2, 1910. Method of supporting the segments of an internal-contact commutator.

1,077,920. ELECTRODE; R. H. Stevens, Salt Lake City, Utah. App. filed Jan. 27, 1913. Iridium-plated tungsten electrode for electroplating electro-metallurgy and batteries.

1,077,937. TRAIN-CONTROLLING MECHANISM; R. T. and F. T. Jones, Baltimore, Md. App. filed May 23, 1910. Ramp-rail system; after automatic application of brakes, brakes cannot be released until train is brought to full stop.

1,077,942. DYNAMO-ELECTRIC MACHINE; G. Sayre, Dayton, Ohio. App. filed May 16, 1912. Self-regulating constant-current machine which will maintain practically constant its own current output under large variations of speed.

1,077,948. CIRCUIT-CLOSING DEVICE; W. W. Alexander (deceased), Denver, Col. App. filed Feb. 21, 1911. Contacts vibrated into engagement with each other by the passing of a train.

1,077,953. METHOD OF AND APPARATUS FOR ELECTRIC WELDING; E. A. Faller, New York, N. Y. App. filed Feb. 13, 1913. Combines in one organization electromagnetic holding means and electric heating means.